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PROBLEMS
OF EDUCATION
IN THE 21st
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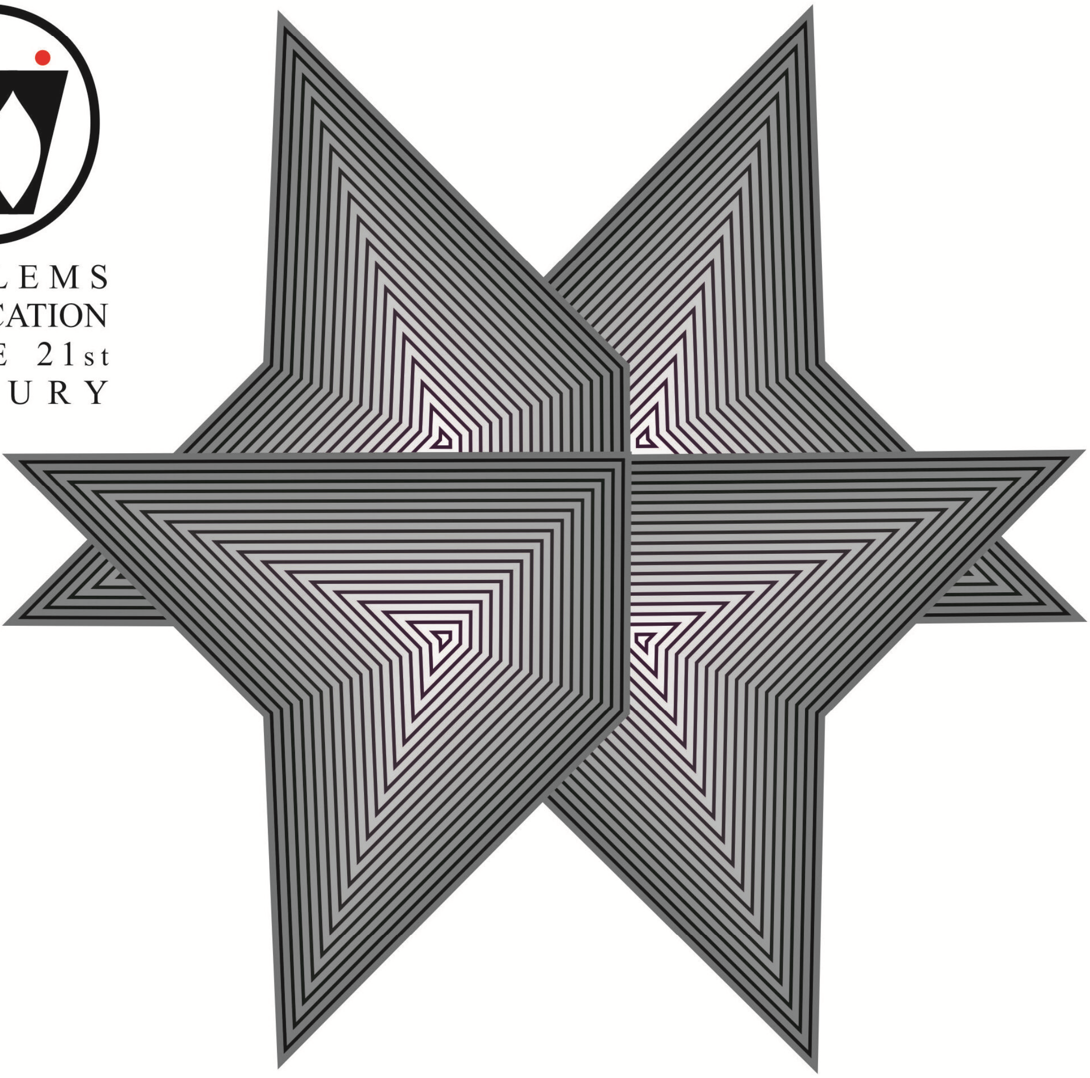

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PROBLEMS
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SySTEMOLOGY OF EDUCATION: SOME THOUGHTS ON THE CONCEPT AND DEVELOPMENT

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S*ystemology of education* is the field of general systemology. On the other hand, systemology of education can reasonably be considered a structural part of contemporary education. There are many different arguments to substantiate such a position. For example, during the last two decades, educational (pedagogical) terminology has changed extremely rapidly. Education science has become more diverse than ever. Such branches as cooperation pedagogy, nonviolence pedagogy, pedagogy of the oppressed, peace pedagogy, success pedagogy, career pedagogy, theatre pedagogy and many others have appeared in educational scientific literature, not to mention the level of education. On the one hand, we do not deny the existence of these branches, on the other hand, the question arises about the scientific system in education in general (Lamanauskas, 2012). It is obvious that the development of education is characterised by two opposite trends – differentiation and integration. In such an abundance of currents, branches, directions, etc., it is not only easy to get lost, but it is even easier to lose the ability to identify mutual relations and define the place of each of them in the common stem of education science. It is firstly. Secondly, the need to integrate education and other sciences becomes even more evident. It is reasonable to think that the time has come to systematise all this. As Vaitkevičius rightly noticed, today's didactics has been flooded by a large number of pedagogic theorists (and even more imitating them) and teacher practitioners, looking for answers to partial teaching/learning organisation questions and creating a partial theory of didactics mostly in an empirical way (Vaitkevičius, 1998). The situation of the time is obvious – no one dares to create comprehensive theories, systems, or at least try to conceptualize educational ideas. Still hope remains. According to Vaitkevičius, it is necessary to believe that these extensive searches in the field of didactics will sooner or later bear the expected fruits and the modern-day Comenius will be born, classical didactics of the modern times will be formed, reflecting the personality of today's student, giving a complete picture of his/her teaching, training, upbringing in the teaching/learning process (Vaitkevičius, 1998). According to Broks (2001) systemology is applied philosophy and psychology, general theory about putting the world in order. Broks treats education as the spiritual and physical arrangement of a man (Broks, 2016).

It is understandable that the interaction between human and the surrounding environment is very complex and multifaceted. It can be said that the educational effect (impact) affects a person in the most diverse systems. The process of impact and the result of impact are two important objects of systemology of education.

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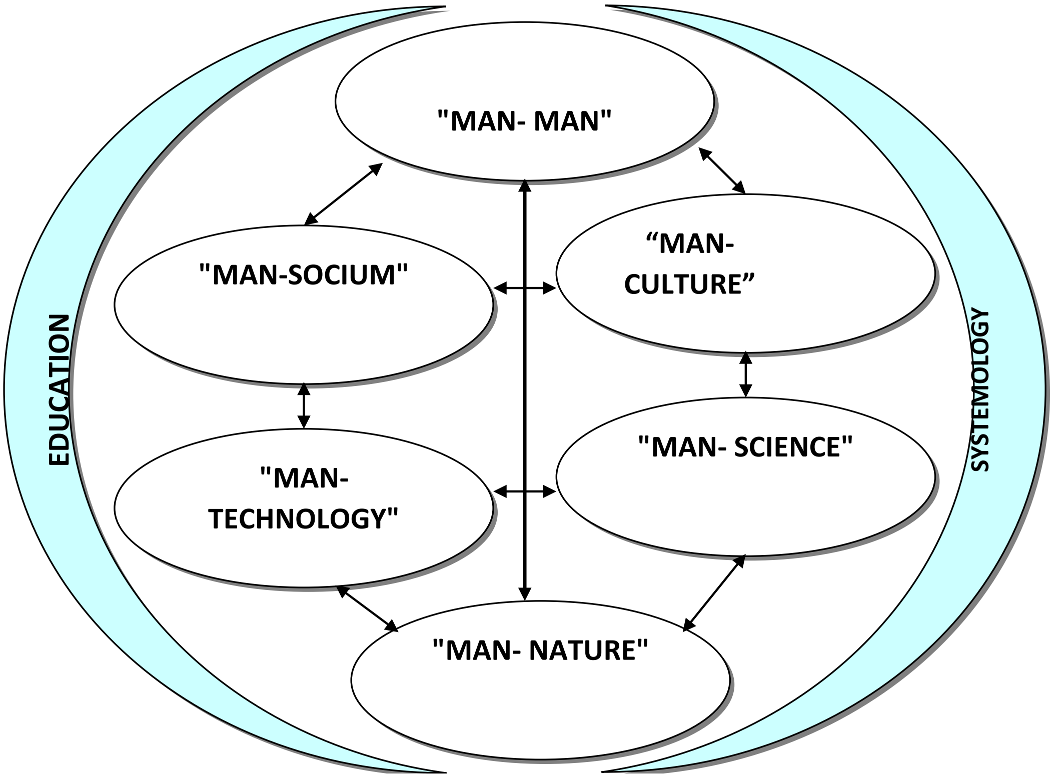
Figure 1
Systemology of Education is the Arrangement of Various Effects on a Person in Various Systems



In addition, each of these six systems consists of the most diverse level subsystems, in which educational impact is different (in terms of process and result).

Systemology of education operates with such concepts as *system*, *systemics*, *systemic*, *systematization* and even *systemtechnics*. The terms *systemic planning*, *method of systemic analysis*, *systemic orientation*, etc., are also used. Sometimes the method of systemic analysis is equated with systemic access (Tidikis, 2003), however such equalisation is not justified. It can be said that many concepts of general systems theory permeate the language of education. The term *system approach* is often noticed in education (Bhaskar & Lajwanti, 2019; Dunn et al., 2007; Dunst et al., 1987; Herrold, 1974).

On the other hand, systemology of education can also be treated as a field of social systemology because education is not only a socio cultural, cultural historical, anthropological phenomenon, but also a system and a social institute. The term *pedagogical systemology* is quite widely used (Prikot, 1995, 2001). It is obvious that in foreign scientific literature both general (Brim, 1975; Laszlo, 1972), and systemology of education questions (Broks, 2001; Faye, 1999; Fend, 1981; Knight, 2002; Kron, 1991; Stones, 1986; Rowley, 2002) are thoroughly analysed. Lithuanian scientists have also analysed one or the other issues of educational systemology (Laužackas, 1999; Šermukšnytė, 1996; Targamadzė, 1996; Vaitkevičius, 1968, 1975), however, it is necessary to note that research in this field is not abundant. Vaitkevičius paid a lot of attention to analysing the issues of students’ knowledge systematization. In the book "Deepening students’ knowledge in the teaching process” (1968) Vaitkevičius analysed the issues of systematisation of knowledge in detail. According to Vaitkevičius, the systematisation of knowledge, as a process, requires the knowledge imparted to students and assimilated by them to be combined into systems according to the affinity of this knowledge, i.e., to classify them on the chosen basis (Vaitkevičius, 1968, p. 9). And this has to be sought because "the system of knowledge allows a deeper knowledge of reality, its objects, phenomena, their essence, and reasons" (p. 9).

> "A human's system of knowledge about reality also determines the system of his relations with the environment, regulates his mental and practical activity. A human's personality is formed in his conscious activity, which is determined by the entire system of knowledge" (Vaitkevičius, 1968).

In his later works Vaitkevičius consistently developed the issue of knowledge systematisation. According to the professor, in the absence of organic connections between individual images and facts, students are presented with local knowledge in the topic, facts that never form a system in the child's consciousness, and do not rise to the level of theory (Vaitkevičius, 1979, p. 17). Education science history knows many examples, reflecting the desire to systematise knowledge, to know the reality systematically. Comenius, the pioneer of classical pedagogy, created a unified philosophy, which he called *pansophy*. According to Comenius, "everyone has an innate desire to have the whole thing rather than its individual pieces, to not tolerate narrow boundaries and to always strive for the whole rather than the part (Komenskis, 1986, p. 377). The ideal of a harmonious personality was raised by Pestalozzi. Although Pestalozzi considered observations to be the basis of students' mental development, however he understood that the knowledge gained in this way is not clear until it is organised. Pestalozzi asserted that it is necessary to "learn to organise your observations and finish what is simple" (Pestalocis, 1989, p. 105). It is safe to say that the idea of knowledge systematisation is one of the essential elements of his elementary teaching theory.

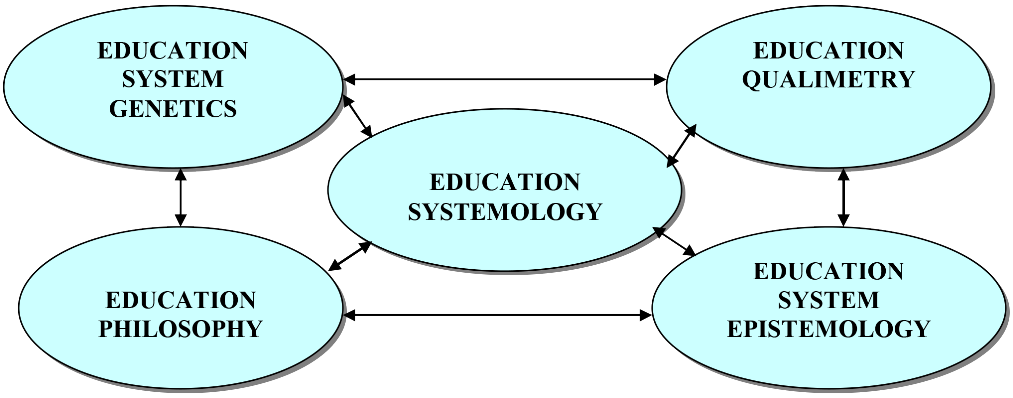
Since the beginning of the 20th century, scientists try to systemise (combine) subject knowledge, by applying the principle of systemic approach. However, one can state that in the first half of this century such attempts were more of mechanical nature (the methods of one science were "transferred" to other sciences). And only from the middle of the 21st century, the attempts to apply systemic approach are much more fruitful. Two different approaches are forming – *natural science* and *humanitarian.* This was also influenced by the rapid development of other sciences such as psychology, philosophy, anthropology, hermeneutics, and others. From this point of view, systemology is a relatively young science. It is worth reminding that the idea of creating a general theory of systems belongs to naturalists – the Austrian biologist Ludwig Von Bertalanffy (1901-1972). At the beginning of the 20th century and especially after 1930, systems become the research object of mathematicians. Mathematical theory of systems, cybernetics, control theory, artificial intelligence and other theories are being formed. So, it is not surprising that the question about a general theory that examines systems arose. According to L. von Bertalanffy (1969), one of the most important ideas is interdisciplinary *General System Theory (GST)*.

Nevertheless, it can reasonably be stated that the creation of general system theory was one of the greatest achievements of the 20th century (Mina Fayez, 2004). An interesting fact can be mentioned that the physicists at the conference held in 1987, in Rome /Italy/ were not able to agree on the definitions "simple system", "*complex system*". Therefore, the terms *systemology*, *systemic analysis*, *systemosophy* are often used. For example, there are those who argue that general systems theory is the same as a systemic approach (Harrell, 1978). According to Langlois, systems theory is very diverse (Langlois, 2004). It should be noted that we often make a lot of mistakes regarding complex systems. On the other hand, a person is able to explain them, systemise, what makes the prerequisites to avoid them. Interesting publications on the issues of general systemology can be found in the "International Journal of General Systems" (ISSN 0308-1079) (https://www.tandfonline.com/toc/ggen20/current).

It is also important to emphasize the fact that the issues of teaching individual disciplines are analysed using a systemic approach, e.g., Systemic Approach in Teaching and Learning Chemistry /SATLC/). In addition, educational modelling is an integral part of educational systemology. Systemology of education is related to all educational disciplines. Systemology of education relations with some other subjects/areas are shown in Figure 2.

Figure 2

Systemology of Education Relations with Other Areas of Education



Without trying to show the entire panorama of educational systemology today, we will mention that at the present time, there exist various directions of this science. For example, in the systemology of education systems, one can distinguish such directions as knowledge systemology, personality culture systemology, pedagogical systems systemology, education fundamentalisation systemology, systemic education anthology, etc. It is also necessary to mention such directions as educational innovation, education system typology, education system management, etc. It is obvious that systemology of education is acquiring a new quality, its significance, interest in it is constantly increasing. Recently, there has been more and more discussion about the development of various fields of education. What is it, a system of various pedagogies or a unified science of education as a system? Researchers emphasize that education science still lacks a clear systematic methodology. Education itself is treated as a systematic and purposeful process of teaching and upbringing, satisfying the interests of a person, society, and the state (Lamanauskas, 2004).

In summary, it can be said that systemology of education is a rapidly developing branch of education. It is worth noting that the low development of this field in Lithuania was caused by 50-year lasting Lithuanian education science separation from Western experience. It can be said that a certain part of people only imitated "doing science" but did not really contribute much to the field of science education. In other words, they were occupied in educational babble (*edu-babble*), empty talk. Therefore, it is safe to say that knowing the ABC of educational systemology is one of the main instruments for effective educational change. On the other hand, systemology of education is not only the knowledge of systems in this field. The design of educational (pedagogical) systems becomes an extremely important issue. It is obvious that the use of the term *systemological education paradigm* becomes justified in the development of science education. On a practical level, that's the systemology, which allows to holistically explore educational phenomena, objects, and processes.

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EXAMINING INTEGERS-BASED MATH GAME CREATED BY A FOURTH GRADE STUDENT

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Abstract

An integer-based mathematical game was the main subject of the study. The aim of this study was to analyse the mathematical content of the game which was developed by a fourth-grade student called Esin, and to examine the intuitive learning that develops through this game. The game was based on the addition of the positive or negative numbers won in each round. The integer is regarded as an abstract topic and is taught in secondary school. It is also regarded as a topic that students have difficulty in learning. However, in the case examined by this research, a fourth grader created an integer addition game using her own intuitive understandings and played it with three of her friends. This research was a case study focusing on the analysis of the game. The study group of the research was Esin and her three friends who played the game. Data was gathered in two stages. In the first stage Esin played the game with researchers and in the second stage Esin and her friends played the game together. All the games were recorded, and the observation form was used to record data. Descriptive analysis, which consists of two codes (cardinal or ordinal meaning), was carried out in data analysis. As a result of the study, it was seen that, Esin had defined negative and positive numbers over the idea of win / lose. Students were able to use both the cardinal and ordinal meanings of the number while playing the game. Cardinal meaning was usually established through the neutralization relation. Ordinal meaning was mostly used over positioning the number relative to zero. This research contributes to the literature on students' learning of integers at an early age.

Keywords: *cardinal meaning, educational games, intuitive learning, negative numbers, ordinal meaning, primary school students*

Introduction

Learning begins in social life. Concepts such as numbers, counting, comparing numbers develop through our daily life experiences before starting formal education. In other words, our experiences in everyday life form the basis of intuitive learning. This intuitive learning is sometimes seen in children's games. So, games can provide opportunities for children to develop various mathematical skills.

Children use the skills and knowledge they have accumulated so far while playing, and they can transform their knowledge into another form of information within the game (Bennet et al., 1997). Children who use their current knowledge while playing games can also make

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connections between the information schemes they have, thus reinforcing the knowledge they have learned (De Holton et al., 2001). In addition to these comments on the relationship between game, knowledge and learning, Faulkner (1995) argued that game is a process based on real life experiences in which the foundations of mathematical thinking are laid.

Game is an art of learning (Yıldız, 1997) or it can be considered as a learning tool used by every child. The game provides active learning environments in which children participate voluntarily. Students both have fun and learn while playing games. Also repeating the game strengthens learning and via games, students become more interested in the subject to be learned. Games, as a teaching tool, contribute to doing mathematics enjoyable, encouraging students to work individually or in groups, and the reinforcement of knowledge (Uğurel & Moralı, 2008).

Games can therefore be created in accordance with the curriculum, just like other teaching materials, and become a component of instructional activities. Educational games are used for this purpose in groups of a wide range of ages from children to adults (e.g., Amalia et al., 2018; Kim et al., Norton, & Samur, 2017; Rossiou, & Papadakis, 2007). Apart from the games designed by educators, the games developed by children in the course of daily life can also be educational.

The game, which is the subject of this research, was designed by a fourth grader by using her own life experiences, not by educators. The game was based on the intuitive learning of its designer Esin and the addition of negative and positive numbers. Esin was only in the fourth grade and had not yet learned integers when she created this game.

Natural Numbers to Integers

Learning about the concept of counting and numbers starts within the children's own culture and social environment (Butterworth, 2005). Games play an important role in this learning. Children sometimes count by skipping some numbers, though by imitating someone. And sometimes they compare the number of toys with each other’s in the game by using the “more or less” relation. As they get older, the games they play and the level of mathematical knowledge in these games change as well.

Throughout our lives, we encounter situations where numbers are used for different purposes. Numbers can be categorized as nominal, formal, cardinal, and ordinal according to their way of use. Nominal numbers are mostly used for labelling / naming and do not have a quantitative meaning (Haylock & Cockburn, 2013). For example, the number on the bus 220 is a label, and our cell phone numbers are denominations of us. In the formal meaning of the numbers, numbers are used in an abstract context and students algebraically approach numbers, they do generalizations from what they already know (Bishop et al., 2014). For example, a child who encounters the expression -3 - - 3 may deduct that "when a number is subtracted by itself, the remaining would be zero" without any knowledge on operations with negative numbers. This generalization is related to the formal entity of the number. In the cardinal meaning of a number on the other hand, a relation is constructed between the number and the quantity. It is creating a relation between the last number used while counting objects in a group and the quantity of that group (Gelman, & Gallistel, 1986). Ordinal value/meaning is related to the concept of ordering, and it means that students for example perceive the set of integers as in an order, as positional and use numbers over ordinal or positional relations (such as -3 is a number greater than -4 and smaller than -2) rather than the quantity they express (Bishop et al., 2014).

All these meanings constitute the concept of numbers as a whole. In order to accomplish meaningful learning, these meanings must be learned together. For example, for a child who only understands the concept of numbers over cardinal meaning, the number -4 cannot be the number of elements of any set. This makes it difficult to understand the negative numbers. Understanding the numbers only as the quantity of a group of objects creates an effect that makes it difficult to learn the integer set (Fischbein, 1987; Otten, 2009). Here it is important to know the different meanings of numbers. For example, in teaching of integers, it is necessary to use activities including the ordinal meaning of the number. There are studies suggesting that such activities facilitate learning negative numbers and that this teaching can be realized even at a young age (Beswick, 2011; Bishop et al., 2014; Hativa, & Cohen, 1995; Sfard, 2007; Wilcox, 2008). Hence, it is important to develop an understanding of all meanings of numbers, especially cardinal and ordinal meanings, in teaching integers.

In a teaching process, where cardinal and ordinal meanings are taken into consideration jointly, it is crucial to employ the number line as a model in addition to the manipulatives. When children learn natural numbers in primary school, they create a number line in their minds that includes the ordering of natural numbers. How this number line can be expanded to cover negative numbers is crucial. To help students to move from using a mental number line only for positive integers to using a mental number line including both positive and negative integers, Vosniadou and Brewer (1992) offered a conceptual framework. In their framework, there exist conceptual information about how children define and think about concepts. This framework has three categories—initial, synthetic, and formal models—that might be used to explain students' mental representations. Bofferding (2014) defined this conceptualization of Vosniadou and Brewer on integers as follows: Students who have "initial mental models" for numbers may use positive integer rules to respond to inquiries regarding negative integers (e.g., students ignore the negative signs and order negative numbers as if they were positive). While allowing for numbers less than zero to exist, the "synthetic mental model" upholds the idea that numbers further along in the counting sequence from zero have bigger worth (e.g., since -6 is farther from zero than -3, it is bigger than -3). The number sequence is extended in a "formal mental model" of an integer, with the negative sign coming before the numbers that are ordered to the left of zero and the numerals symmetric about zero (e.g., -3 is greater than -6 because it is closer to 0 than -6).

Peled (1991), who examined the mental models of students in the learning process of integers, defined four understanding levels. At the first level of understanding integers, students are familiar with the symmetrical ordering of numbers around zero as well as the order of all integers. Students can add positive numbers to any integer at the second level; add or subtract two positive or two negative numbers at the third level; and add or subtract any two integers at the fourth level. Considering the studies of Peled (1991) and Vosniadou and Brewer (1992) together, it is expected that students first perceive negative and positive numbers. Then they can order these numbers correctly (it means they have a formal mental model) and finally they can perform four operations step by step (second level to fourth level).

Despite this conceptual framework for students' learning about integers, negative numbers are still one of the known issues that students have difficulty in learning (Beswick, 2011; Bryant et al., 2020; Erdem et al., 2015; Kilpatrick et al., 2001; Van de Walle, 2013; Vlassis, 2008). On the other hand, some studies also reveal that primary school students have been aware of negative numbers, they could order integers, and perform some basic operations (Bishop et al., 2014; Bofferding, 2010; Bofferding, 2014; Cengiz et al., 2018). It is remarkable that a subject that students have difficulty in learning in secondary school can be done in primary school. Examining students' mental models and intuitive learnings of these subjects provide important data on students' learning processes. Studies on integers with younger age groups are crucial for this reason. Students' intuitive learning constitutes their pre-knowledge. The teaching procedure can be better planned with the help of these pre-learnings. In this study, students' intuitive learnings that they gained through the game were examined.

Research Aim

The game developed by fourth grader Esin was the focus of this study. The researchers were not involved in the game's development. Esin and her friends, who had been playing the game together for a while, were discovered by one of the researchers. The development of a game on a subject that secondary school students had a difficulty in learning by primary school students was an interesting case. Additionally, fourth graders in this game were somehow adding negative and positive integers. It was thought that the mathematical content of the game and the mental models of the students while doing the addition would reveal crucial information about the students' learning processes. For this reason, the aim of this study was to analyse the mathematical content of the game and to examine the intuitive learning that develops through the game. Therefore, this study sought to answer the following research questions:

1. What was the mathematical content of this game developed by Esin?
2. What did the students learn about integers and addition in integers through the game?

In other studies, with younger age groups (Bishop et al., 2014; Bofferding, 2010; Bofferding, 2014; Cengiz et al., 2018; Wilcox, 2008) students were asked questions that usually included integers. Students' learning was examined through their answers to these questions. In this study, unlike the others, a situation that exists outside the intervention of researchers was analysed. The study is original in this regard.

Research Methodology

General Background

This research was designed as qualitative research. It was a case study focusing on the analysis of the game developed by Esin. Case studies are a type of research in which the researcher collects detailed and in-depth information through multiple sources of data such as observation and interviewing about a current limited situation in real life (Creswell, 2012). The situation can be an event, a person or a small community, and this reality is investigated in detail through the case study (Merriam, 1988). In this study, the game, namely the mathematical content of the game and game-based learning, was the case of the research. Throughout the research the game was named as "Let's put here a number with minus sign”. This was a phrase that students often used in the game.

Study Group

In this research, the game "Let's put here a number with minus sign” is considered as a case. The person who created this game and her three friends who played this game with her constituted the study group of this research. Four female fourth graders who created and took part in the game were chosen as the study group, and a purposive sample was created. These four students had been attending a primary school in Ankara, Turkey, together with kids from middle-class families. Families of all four participants were well-educated, and at least one parent held a university degree. The families of the participants gave their permission for the study, and the participants were informed about the research. Also, the names of all participants were changed, and new names were given to them. Throughout the research, the participants were named as Esin, Buse, Nazlı and Esra. According to their grades and teachers’ view, these participants had different success in mathematics course. Esin and Nazlı were described by their teachers as successful students, while Buse was a student at the intermediate level. Esra, on the other hand, was defined as a student who had difficulties in mathematics lessons.

Instrument and Procedures

This research was carried out in 2018. The data collection process included the following stages:

Stage 1: First, Esin was asked to explain to the researchers the game and how to play it. Esin and the three researchers then played the game together. In the meantime, the researchers constantly asked Esin how to proceed in the game and she was told to explain the mathematical content required by the game to them. The game was recorded as a video. Afterwards, this video was watched, and two researchers filled out The Observation Form 1 (see at App.1) separately. Then, the two researchers compared the observation forms they filled in and completed the missing notes. The observation form consisted of some questions about the game, and some empty spaces to write the operations, justification of the operations and the duration. For the observation form, the expert judgment of two academicians was sought.

Stage 2: After a week, Esin and her friends played the game together. In this second game, the researchers focused on the information that Esin and her friends learned through the game. While playing the students also explained the reason of the operations to the researchers. Each player explained what she was doing and how she was thinking while playing the game. This game was also recorded as a video. In the video analysis, The Observation Form 2 (see at App.1) was used. For the observation form, the expert judgment of two academicians was sought.

Data Analysis

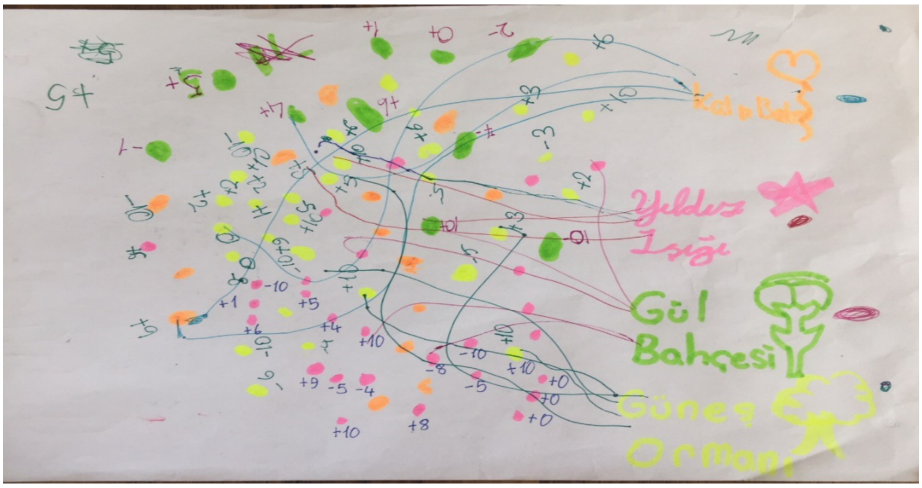
Game videos were watched and analysed by two of the researchers. Coding was performed according to which meaning of the numbers is used. The participants' expressions were coded over whether their expressions include the meaning of cardinal or ordinal value. So descriptive analysis, which consists of two codes (cardinal or ordinal meaning), was carried out in data analysis. The coding was done separately and then the encodings were compared for reliability of the research. The consistency of encodings was first at 80% according to Miles and Huberman’s (1994) formula, and then with the inclusion of the third researcher the inconsistencies were discussed. After this discussion, the coding consistency was achieved and on the different coded portions, a decision was made jointly. Direct citations from the discussions were used when reporting the findings, this strengthened the validity of the findings.

Research Results

Mathematical Content of the Game “Let's put here a number with minus sign”

The game required a coloured pencil for each player and a blank paper. The game could be played with at least two players. First, each player chose one corner of the paper as their starting point and named it. As it can be seen from Figure 1, the starting points in the game designated by researchers and Esin were named as “Sun Forest”, “Rose Garden”, “Starlight” and “Heart Balloon” from bottom to top.

Figure 1
The Image of a Finished Game



Each player then randomly placed numbers between 0 and 10 on the paper. “If we want to make it harder, we could use numbers up to 20” said Esin while the researchers were writing down the numbers. “Now put a minus or a plus sign next to the numbers” she added after that. Meanwhile, Esin explained the meaning of plus and minus signs as follows:

Researcher 1: Why do we put minus and plus signs?

Esin: You lose points with minus and gain them with plus.

Researcher 2: Well, should we write down the number first and then put the plus or minus sign next to it? [Referring to 3- or 3+ notation]

Esin: No, it should be like minus 3 and plus 3. So, first sign then number.

As it can be understood from this dialogue, Esin defined positive and negative numbers in the game over the cardinal meaning of the number (by establishing a relationship between number and quantity), associating the positive state with the gain and the negative state with the loss. She also correctly used symbolic representation of negative and positive states of the numbers like in the example of "minus 3, plus 3". In Turkish, there is only one word for “negative” or “minus”, and only one word for “positive” or “plus”. Therefore, the expressions of these students who had not yet learned the negative and positive numbers were translated by using “minus” and “plus”.

Afterwards Esin told how to play the game as follows; “We start drawing a line from the starting point while our eyes are closed and randomly stop at somewhere. I'll get the point where I stop. Then we add this new point that we acquired to our previous point. At the end of the game, the player who gathers the highest points wins.” In these sentences, Esin described a game based on the addition of positive and negative numbers. In order to calculate the points earned in the game, the numbers that we arrive to or get close to must be added. These numbers can be positive or negative. So, how does Esin performs addition with negative numbers?

The second round started after each participant recorded the number of points they initially reached. In the second round of the game, adding negative and positive numbers began. Since the researchers didn’t know how to add integers in this game, Esin did all the calculations for them. Esin explained what each player was supposed to do after reaching the second number in the following:

Researcher 1:	(-1) + 0	Esin: "You add 0, nothing changes, you are still minus 1."
Researcher 2:	(+1) + (+2)	Esin: "You were plus 1, adding plus 2 you become plus 3."
Esin:	(-2) + (-8)	Esin: “It is minus 10, because we've added the minuses, and when we add the minuses, our number with minus becomes greater. ... we now have a greater number with minus.”
Researcher 3:	(-10) + (-2)	Esin: “You became minus 12. As you have more minuses.”

As it can be understood from her explanations, in the second round of the game, Esin provided a justification for the sum of two negative numbers, which she had not yet learned at school. Here Esin explained negative numbers with respect to their cardinal value and she described -10 as "we now have a greater number with minus”. What she actually means here is that the amount of that player's loss becomes greater quantitatively. At first, from her expressions of "our number with minus becomes greater” and "we have a greater number with minus” it can be thought that Esin had a wrong perception about comparing the magnitude of negative number, but it was observed later in the game that she also developed a correct perception about ordering integers.

As the game continued, both numbers and the difficulty of operations increased. Later in the game, some of the operations that Esin explained are as follows:

(+8) + (-6)	Esin: “I become plus 2. When I reach minus 6 my points drop, I lose 6 points. After that I am left with plus 2.”
(+3) + (-7)	Esin: "when you reach minus 7, after adding points, you become minus 4. First, we ***subtract*** 3 from 7. When we subtract 3 from 7, the plus sign is reset. What is left is 4. And that becomes minus 4 because of the minuses.”

Here Esin made her expressions with respect to the logic of elimination or neutralization of plus and minus signs in two-color counters, meaning the cardinal value. It was observed that Esin also used the concept of “subtraction" when describing the addition process in integers. For example, when calculating (+3) + (-7) Esin who used the expression “First we'll subtract 3 from 7” established a subtraction logic from the neutralization relation between minus and plus values. However, it was also observed from the dialogues later in the game, along with cardinal value of negative and positive numbers, Esin was also able to construct an ordinal (ordering) relation between these numbers. For example, the researcher 2 and Esin had the following conversation for (-12) + (+4):

> Esin: You were at minus 12. It will still be ***more*** in the negative but not yet 0. You couldn't pass zero. Since you get +4, we will find it by subtracting 4 from 12. You became minus 8.
> Researcher 2: You said it will be more, but what is more?
> Esin: Your minuses will still be more; you couldn't reach to zero. You are still in loss.
> Researcher 2: Why did you subtract 4 from 12?
> Esin: I have subtracted 4 from 12 because I got ***more*** points, it should have been higher. You get higher in numbers with minus by subtracting.

In this dialogue, Esin used the word “more" for twice but with two different meanings. At the beginning of the dialogue by saying “it will still be more” what she meant is that the researcher is still in loss, comparing her points with zero. In her later expressions she used a correct ordering relation between negative and positive numbers. She defined the gain by taking +4 as getting higher from -12 and she considered -8 as a "higher" number compared to -12. The word "more" that she used for the second time on the other hand has an ordering logic, different than the first. While sharing information about the addition in integers, Esin showed in her own words that she had a correct reasoning relating to the ordering in integers. Esin's explanation of (-1) + (+1) also followed an ordinal approach; "We add minus 1 with plus 1, you became 0. As you were minus 1 and we added 1 to it. When we add 1, the point of minus 1 gets higher and it becomes 0". Esin defined the greater numbers in integers by the concept of getting "higher".

At the end of the game, Esin answered the question of "who won?" by making a correct ordering in integers. This time a smaller number was defined by the word "less".

Researcher 1: I'm at -10, Researcher 2 is at 0. Which of us has a higher score, who won?
Esin: Researcher 2.
Researcher 1: Why?
Esin: Because she is zero, you're less than zero.

Esin's explanations about the game showed that this game was based on the cardinal and the ordinal meaning of the integers. Throughout this game, Esin could use these two meanings of integers together. For example, while describing the relationship between being greater and smaller in integers she referred to number's ordinal meaning while using the concept of "higher” and referred to its cardinal meaning while using the concept of "less".

Learning through the Game

A week after the meeting where the game was learned, this time friends of Esin with whom she played this game for a while joined her. Esin, Nazlı, Esra and Buse were classmates. They were students at a primary school where children of middle socio-economic class families are educated, in Turkey's capital Ankara. They performed differently in mathematics and this difference could easily be observed while they were performing addition operations in the game. For example, each student did the addition at a different speed. During the game children were able to discuss on operations that they did, object to each other and remind some information to each other. So, the game was played in its natural flow.

All four of these friends were asked to explain the operations they performed with their reasons while playing the game. It is observed that with the help of the game children had different levels of improvements in their understanding relating to cardinal and ordinal meaning of the integers. However, their terminology was sometimes mathematically incorrect. Even though they used an incorrect expression, they actually meant something different. For example, when Nazlı arrived at -5 while she had +2 points, she declared that her score was now -3 and explained it with the following words: “because when you subtract it from plus two, what remains is 3”. Similarly, when Esra had +1 point and she arrived at -3, she declared that her score became -2 and she said, "I subtracted plus 1 from minus 3, since it is 3 which is minus here, I subtracted plus 1”. Here neither Nazlı nor Esra meant the operations of +2 - (-5) and -3 - (+1). The concept of “subtraction” that they used in their statements actually described the process of neutralization of the pluses and the minuses through the relation of cardinal value. As the sum of the points they gathered, they used the remaining value after this neutralization process.

Another misuse was caused by the similarity of the number signs and the operational symbols. When she arrived at -1 with -2 points, Esra who was a bit slow from others while doing operations said, “because I had two minuses and I got another one, I add them when they are same operations”. Esra used the idea of putting together the same-coloured counters in this operation. Since she was accustomed to use + and - symbols while performing operations, she used incorrectly the word "operation" at the end of the sentence while talking about negative values.

Buse, who had arrived at +2 with -8 points at this round, explained how she performed addition operation by saying she had "lessened" her minus points with plus points she'd just got. There is a cardinal meaning in her explanation, too.

Buse: -8, adding +2 I became -6.

Researcher 1: How did you become -6, Buse?

Buse: Arrived at +2, we need to lessen them [meaning her points] by 2 which makes -6.

There were few moments in the game when they had incorrect results, or they didn't make the right explanations. In such moments, children were able to object to each other and discuss it together. The discussion about the total score of one of the children sometimes was brought into question the rules of the game. Sometimes it had been observed that these discussions improved children's learning. For example, in one of the rounds, Buse and Esra got confused at first by the points Esin got in her turn and they objected to the operation she performed. During the discussion (after the rule of the game was reminded) Buse made a comment on the relation of ordinal value (ordering) in addition to cardinal value of integers. At the beginning of this round, Esin had -1 point and she arrived at -5. Then;

Esin: I became minus 6.

Researcher 1: How did you find the result?

Buse: Nooo, you got -5, you should become -4.

Esin: No that is correct, if I add minus 5 to minus 1, it's minus 6.

Esra: Why are you adding them?

Buse: You should add if it is plus, but you got minus.

Researcher 1: What was the rule of your game, Esin? How do you find the total score?

Esin: We need to add the numbers.

Buse: Right Esra, it will be -6, -6 is more, now which one is more; minus 1 or zero? Minus 1 is more.

Researcher 3: What does it mean more? Which one of these numbers is lesser or greater?

Buse: Now I'm minus 4, minus 6 is more than me. Because it is actually lower at the end. Because it's more due to the state of decrease. Now Esin has decreased even more. Esin was right.

Buse, who initially objected to the result, was aware of the fact that Esin lost more by arriving at -5. Children sometimes get confused about which operation to use because of the signs in front of the numbers. In this example, immediately after being reminded that the score would be calculated by adding the points they got, Buse realized her mistake and took the discussion to a new level. In this discussion, Buse used the word “more” in a similar context to Esin's by saying: “Now I'm minus 4, minus 6 is more than me. Because it is actually lower at the end”. Even though this sentence looks like self-contradicting, in fact it has both cardinal and ordinal value relation of numbers in it and therefore it is true. She simply didn't use the proper mathematical terminology in her explanation. However, it should be noted that these kids are in fourth grade.

Buse presented a win-lose argument by claiming that Esin, who had minus points, lost "more" by reaching another minus point by saying “because it is more due to the state of decrease”. Here, Buse used the word “more” through its cardinal meaning. And by saying

"Because it is actually lower at the end" she made an ordinal reasoning and said that Esin had the lowest value of points when compared to others.

The terms children used were sometimes incorrect and sometimes they had different meanings. Despite this, they could explain us the addition of integers which they had developed through game. These expressions showed that their knowledge about integers was not limited to cardinal value, but they could also establish an ordinal relationship between numbers. In addition to Buse's statements mentioned above, in another round of the game Nazlı first miscalculated her score and then realized her mistake and made the following statement: (Nazlı had -3 points, then she arrived at +2)

Nazlı: It becomes +1.
…
Nazlı: No, it is wrong. [looks back at the paper] it is -1.
Researcher 2: Why did you change it? Which one is true? I don't get it.
Nazlı: Look, if it was a number greater than minus 3, say 4, it would pass over plus side. But since it was less than minus 3, it couldn't pass over that side.

With a number greater than -3, Nazlı meant numbers like +4, +5. According to her, being greater than -3 meant that if it was added, the result would reach a level above zero and being less than -3 meant that if it was added, it couldn't make it pass or reach zero. Thus, her expression of "pass over plus" had an ordinal meaning.

The dialogues in this game also showed that Esin and her friends were able to use both the cardinal and ordinal meanings of the number when adding integers. Sometimes they confused the sign of the number with the sign of the operation, and sometimes they did not use mathematical terms appropriately. Nevertheless, they were able to create a reasoning for adding negative and positive integers as fourth graders.

Discussion

In this research a game created by fourth-year student Esin on a subject she had not yet studied was analysed. The game, named "Lets' put here a minus sign", was based on adding negative and positive numbers. The concept of negative numbers is abstract for primary school students. It is difficult for a student who learns the concept of number primarily through cardinal value, to associate the quantity of objects with negative numbers. Students can understand negative numbers by using win-lose relationships or the idea of debt over the meaning of cardinal value. On the other hand, when teaching negative numbers, the number line, whether it be horizontal or vertical, the thermometer, or the depths below sea level can all be used as examples of ordinal meaning. Despite all these examples that are used to embody the concept of negative number, integer is one of the subjects that students have difficulty in concretizing (Kilhamn, 2008). Pound (2008) pointed out that games encourage children to think abstractly as well as supporting mathematical development. The game that was the focus of this study was thought to have these two effects on students: thinking abstractly and supporting mathematical development.

Negative numbers exist in our daily life practices like the negative temperatures listed on a thermometer and the children are intuitively aware of these numbers. Many studies conducted with young children showed that they had intuitive understanding of integers, or the concept of integer could be taught to them before secondary school (Bescwick, 2011; Bishop et al., 2014; Cengiz et al., 2018; Hativa & Cohen, 1995; Sfard, 2007; Wilcox, 2008). The game analysed in this study reveals that a fourth-grade student Esin has intuitively grasped negative numbers. Esin used states of being plus and minus (in numbers) which she defined through win / lose situation in her game, and she designed a way to perform addition of integers. This intuitive knowledge of hers created the game, and this game promoted some new learnings on integers in her friends she played the game with. By the help of this game Esin, Nazlı, Esra and Buse could perform addition of integers when they were just 4th graders (in Turkey this subject is taught in 7th grade).

Although integers are taught in the secondary school, some studies show that younger students can understand negative numbers, sorting integers, and even adding and subtracting integers (Beswick, 2011; Bishop et al., 2014; Bofferding, 2010). Bofferding (2010) interviewed second grade students about addition and subtraction of integers and examined how they defined the term "minus sing". According to this research almost half of the students, even though their terminology was sometimes mathematically incorrect, were willing to explore more meanings of the minus sign. Although they used incorrect terminology in their expressions as in this article, students were able to develop an idea about a subject they did not learn yet, and according to the researcher they thought comparably better to the students who had had integer instruction. Similarly, in the case study with Violet (Bishop et al., 2014), a second-year student, Violet had shown that those young students already have an intuitive understanding of negative numbers before receiving formal training. The order-based (ordinality) approach that Violet used in addition and subtraction was similar to the reasoning of the students in this study. In this research, students used both the ordinal and cardinal meanings of the number while adding integers and explaining how to add them.

In this research cardinal meaning was usually established through the neutralization relation. Ordinal meaning was mostly used over positioning the number relative to zero. For example, when Esin explained the operation (+3) + (-7), she used a subtraction logic from the neutralization relation between minus and plus values when she said, "when you reach minus 7, … you become minus 4. First, we subtract 3 from 7. When we subtract 3 from 7, the plus sign is reset. What is left is 4. And that becomes minus 4 because of the minuses”. But when she explained the operation (-1) + (+1) she used an ordinal approach when she said, “When we add 1, the point of minus 1 gets higher and it becomes 0”. When students learn natural numbers in primary school, they deal more with the cardinal meaning of the number. Fischbein (1987) emphasized that understanding the number only through its cardinal meaning would make it difficult to learn negative numbers. Therefore, in order to accomplish meaningful learning, these meanings must be learned and used together. As in this research, some other studies have shown that primary school students could also use ordinal meaning. Violet, who was a second-grade student, was one of them (Bishop et al., 2014). According to Bishop and his colleagues Violet had intuitive ideas about integers before the school-based instruction and she could use order-based approach at integer additions. She used a counting strategy up to zero while doing (-9) + 5 operation. Another second-grade student Robbie also used ordinal meaning while explaining (-4) + 2 = -2 operations as “Negative two… it’s just uh, going up, so negative two … is more” (Bofferding, 2010). At this operation according to Robbie adding meant “going up”. All these studies (also including this research) had revealed that students could learn about integers even before secondary school.

In the primary school, mental models for integers can be developed in students. The results of this study also revealed this. The students' statements regarding "who won" after the game and their narratives about negative numbers showed that they possessed a “formal mental model” (Bofferding, 2014). They were able to position negative and positive numbers relative to zero. Even though they did operations at various speeds, they were all generally capable of doing addition with negative numbers. Some of the number pairs reached in the game, also revealed examples that students could add any two integers (e.g., positive, and negative) that was the fourth level of Peled (1991) on integer addition. Of course, this intuitive learning was not enough for learning integers. But this level of learning, which students developed through the game, is important. For Esin, who created the game, included this learning into intuitive knowledge. What needs to be done is to carry this intuitive learning, which students develop in their daily lives, further through school learning.

This research also revealed various results in terms of terminology use. Most of the participants employed their own terms, and even though these expressions occasionally had mathematical errors, they reached the correct conclusion mathematically. The learning that students develop outside of their school learning creates their own terminology that is fed by their lives. In this research, the students explained the large number, for example, with “getting higher”. Sometimes, even though they incorrectly use certain terms, they give those terms a new meaning. For example, sometimes they used the term “subtraction” not for the operation, for describing the process of neutralization of the pluses. Similar to this study, there are other studies in which students create new and their own concepts for that subject area (like Bishop et al., 2014, Maher, & Martino, 1996). These studies usually include topics that students have not yet learned in the classroom. For example, Maher and Martino (1996) examined the development of an idea of proof of a first-year student named Stephanie in their 5-year longitudinal study. In this research, Stephanie used new terms such as "cousin", "opposite of cousin" while describing her intuitive ideas. Although students expressed negative numbers correctly in this research, some students could invent new notations for "negative". For example in a similar another research, a first grader Nola invented a new notation for numbers below zero, she called them the “something” (Bishop et al, 2014). She counted numbers as something 1, something 2, something 3 and wrote them S1, S2 and S3. Language and terminology are crucial components of learning. Examining language and terminology in research on students' learning will provide important data on learning and thinking.

Conclusions and Implications

In this research, intuitive learning about integers developed by students before secondary school was examined. This learning developed through a game, which was intended by one of the participants of the research, Esin. Unlike other studies with primary school students, an existing and discovered situation was analysed in this study. Researchers did not intervene to the study group, the game and the learning created by the game were examined over the existing situation.

When the intuitive learning through the game "Let's put here a number with minus sign" was examined, it had been found that:

- The students defined the state of being negative with losing points and the state of being positive with winning points.
- The final score of the game was calculated by adding every negative or positive points gathered in each round.
- The students were able to use both the cardinal and ordinal meaning of the number while performing addition.

According to the results of the study, fourth-grade students, who were playing this game, could understand negative numbers, add negative and positive numbers, and determine the larger number in integers. They used both cardinal and ordinal meaning of the numbers in all this process. These findings are important in terms of the pre-knowledge that students have about integers in primary school. Curriculum designers should take this pre-knowledge into account, and also intuitive learning / knowledge should be taken into account in the curriculum development process. It is possible to re-evaluate the best time to begin teaching integers in light of this and related studies. Also, this game or any other game to be developed with similar content can be used in teaching integers. Another study might focus on how this game will be used in the classroom, and the effect of teaching with the game in the classroom can be analysed. Teaching via games should be prioritized in subjects that students struggle with. According to this research, through this game:

- Children had illustrated how to use mathematics in real life.
- Doing math had become a game of friends which proved to be fun.
- Learning was achieved in an environment of peer communication.

The advantages of game-based learning, that also was observed in this research, may help to overcome some learning difficulties. In this research, it was observed that a subject, which was difficult for secondary school students, was learned in a fun way through the game by primary school students.

Declaration of Interest

The authors declare no competing interest.

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Appendix 1

Observation Forms

Observation Form 1: Mathematical Content of the Game
How many people was the game played with?
How was the game played?
What were the rules of the game?
What were the meanings of the positive and negative numbers in the game?

First Round			
Operations [like (-3) + (+5)]	Duration (like 12’30’’)	The justification of the operation or dialogue	Code (Cardinal or ordinal)

Second Round (same as the third and the other rounds)			
Operations [like (-3) + (+5)]	Duration (like 12’30’’)	The justification of the operation or dialogue	Code (Cardinal or ordinal)

How Esin explained “Who won the game and why”?

Observation Form 2: Learning Through the Game			
Operations [like (-3) + (+5)]	Duration (like 12’30’’)	Student name, her justification of the operation or dialogue	Code (Cardinal or ordinal)

The dialogue about “Who won the game and why”?

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ADAPTATION INTO TURKISH OF THE COMPUTATIONAL THINKING TEST FOR PRIMARY SCHOOL STUDENTS

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Abstract

Computational thinking is recognized as a vital skill related to problem-solving in technological and non-technological fields. The existence of different sub-domains related to this skill has been pointed out. Therefore, there is a need for tools that measure these different sub-domains. Because of its structure that includes different skills, computational thinking has a structure different from that of the tools used to measure academic skills. Moreover, no special programming knowledge is required for tools that measure this ability. In order to measure this skill in younger age groups, it is possible to apply the measurement tool without adult support. At this point, it is aimed to reveal the computational thinking skills of Turkish children by adapting a test developed for the 7-9 age groups into Turkish. For this purpose, an adaptation research study was performed for TechCheck-2 developed by Relkin et al. (2020). In the study, a total of 372 primary school students studying in Ankara were contacted. Item and test analyses were performed on the data obtained as a result of the application of the test. The distinctiveness and difficulty values of the items making up the test and Kuder Richardson-20 scores were calculated. At the end of the analyses, it was seen that the test could be used as a valid and reliable measurement tool for Turkish children.

Keywords: *computational thinking, item analysis, test adaptation, primary school student*

Introduction

Humankind is in a massive technological transformation. During this transformation, people who are integrated with the industry 4.0 revolution will have to produce solutions to new events and problems that they have never encountered before, and to continue their existence by thinking in new contexts and systems. While some jobs will be disappeared from the face of the earth, futurists emphasize the importance of individuals making decisions that determine their career goals and future decisions and developing themselves in line with these decisions. In this respect, today's educational institutions should adopt a proactive approach, educate individuals in accordance with their future vision, and equip them with the necessary skills. Computational thinking (CT) can be considered one of these skills (Denning, 2009) because as the importance of problem-solving skills such as abstraction, decomposition, algorithmic design, generalization, and evaluation increases, the interest in developing CT thinking in schools has started to increase (Voogt et al., 2015). This interest stems from the need to learn digital languages, which are necessary to be successful in the digital world, to learn coding as a way of solving problems and CT as a working paradigm (García-Peñalvo & Mendes, 2018). This emerging need indicated that CT thinking skills should be gained from an early age.

According to Wing (2008), CT skill is an approach that incorporates computational fundamental concepts for solving problems, designing systems, and understanding human

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behaviour. This approach is a set of ideas that allow individuals to understand the world around them (Brennan & Resnick, 2012; Chalmers, 2018). Denning and Tedre (2019) considered some mental practices necessary in order to put these ideas into practice. The International Association for Technology in Education (ISTE, 2011) states that CT is a problem-solving process in which formulations are made using computers and other tools, emphasizing that it is a combination of organizing and analysing data that puts data in a logical order and automating solutions through algorithmic thinking. D'Alba and Huett (2017) have stated that in order to understand CT, it is necessary to distinguish between what computers can do better than humans and what humans can do better than computers, and that problems can be solved only by designing efficient systems in this way. Shute et al. (2017) examined the models in the CT-related literature and defined CT as the conceptual basis needed to solve problems effectively and efficiently (e.g., with or without computer aid with algorithms) including solutions that can be used in different contexts. Berland and Lee (2011) have considered CT within five categories (conditional logic, algorithm building, debugging, simulation, and distributed computing) and two stages (local logic and global logic). In the literature, it is seen that algorithmic thinking, debugging, and parsing dimensions are frequently mentioned (Tosik Gün & Güyer, 2019; Üzümcü & Bay, 2018). Grover (2021) has stated that CT is an important tool for participation in the 21st century career opportunities and cultural context in both academic and non-academic settings. Therefore, maximizing students' CT skills is important for their future. That is why qualified measurement tools are needed to determine how successful children are in CT activities. Many researchers have stated in their studies that there are deficiencies in measuring CT skills with assessment-evaluation tools suitable for age group and education level, and that the number of valid and reliable measurement tools for CT is low (Tosik Gün & Güyer, 2019). Top and Arabacıoğlu (2021), in their research in which they analysed studies on CT, determined that Likert-type scales were mostly used to measure this skill in research. Assessments based on the person's own evaluations may be insufficient to measure CT skill. In addition, tools measuring skills in different categories related to CT have not yet become widespread enough (Eguchi & Urive, 2009). Research on CT in Turkey have focused mostly on secondary school (Çetin et al., 2020; Güler & Dinci, 2019; İbili & Günbatar, 2020; Paf, 2019), high school (Bulut & Yılmaz, 2021; İbili et al., 2020), and university students (Akgün, 2020; Yel, 2021). Studies focusing on CT skills in younger age groups are relatively rare. This situation can be explained by the lack of valid and reliable measurement tools developed on this subject. Therefore, the development of tools that measure CT skills or the adaptation of tools with international applications to Turkish will support the research in this field. For this reason, in the present research, it is aimed to reveal the CT skills of Turkish children by adapting the CT test (Relkin et al., 2020) developed for the 7-9 age groups into Turkish.

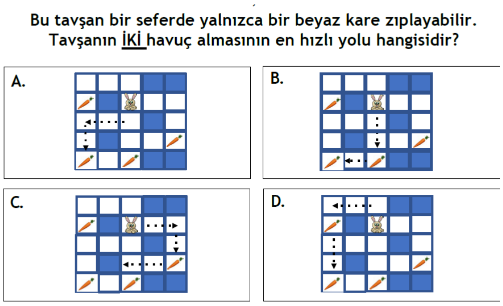
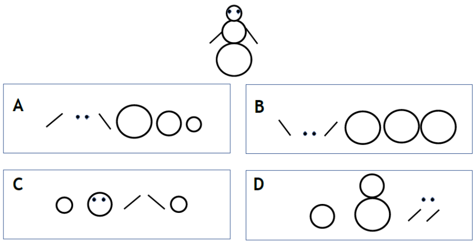
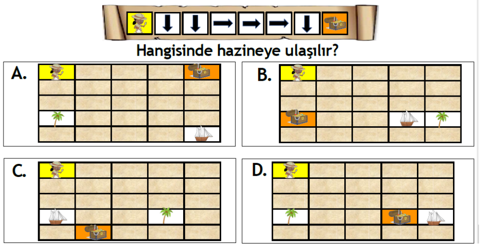
Computational Thinking Test for Primary School Students

Relkin et al. (2020) have developed tests for different age groups entitled "TechCheck". According to this,

- TechCheck-K is best for children 5-6 years old (kindergarten)
- TechCheck-1 is best for children 6-7 years old (first grade)
- TechCheck-2 is best for children 7-9 years old (second grade)

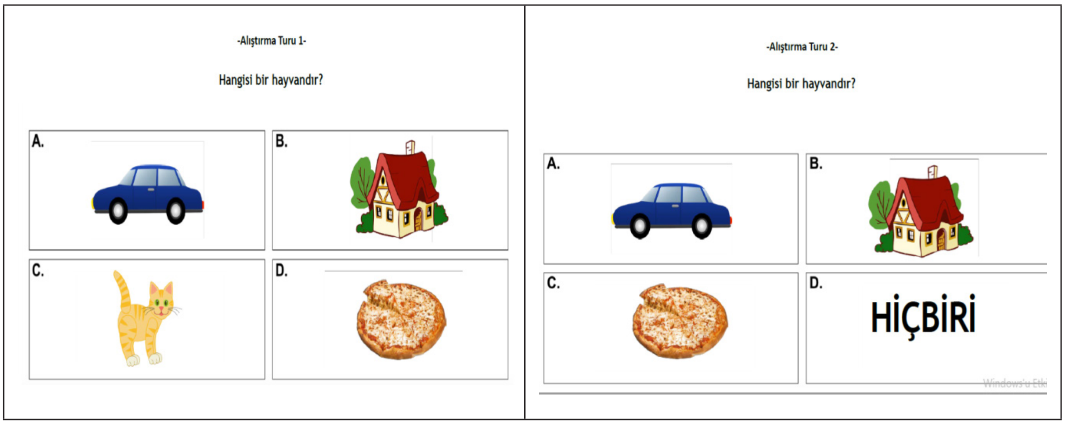
In the present research, an adaptation study on the TechCheck-2 version of the TechCheck test was carried out. For TechCheck-2, students can read and answer questions on their own without the help of an adult (teacher or parent). The test includes questions in four areas covering CT skills. This includes algorithmic thinking (missing symbol series, shortest path puzzles, sequencing challenge), modular structure (object decomposition), control structures (obstacle mazes), representation (symbol shape puzzles), software/hardware (identifying technological concepts), and debugging. There are different types of questions in the fields of symmetry problem-solving. The questions in the test are based on important ideas for CT expressed by Bers (2017). The connection between the question contents and the important ideas is presented in Table 1.

Table 1
CT Test Domains

Domain	Task Type	Sample
Algorithmic Thinking	missing symbol series, shortest path puzzles, sequencing challenge	Bu tavşan bir seferde yalnızca bir beyaz kare zıplayabilir. Tavşanın İKİ havuç almasının en hızlı yolu hangisidir? 
Modular Structure	object decomposition	Bu kardan adamı yapmak için hangi şekillere ihtiyacın var? 
Control Structures	obstacle mazes	Burada hazineye ulaşmak için gerekli olan talimatlar yer alıyor. Buna göre her ok, 1 kutu hareket ettiriyor:  Hangisinde hazineye ulaşılır?

The test can be applied face-to-face or with the help of online platforms (e.g., Qualtrics, Ispring, pear deck). In the face-to-face application, an average of 12 minutes is sufficient. The questions in TechCheck-2 are similar to those in TechCheck-1, but the level of difficulty varies. There are 17 questions in total in the test, but the first two questions are not included in the scoring (Figure 1). The first two questions at the beginning of the test are included as practice round questions. The questions in the test are scored as 1-0 and the total score is calculated. There are four options in the multiple-choice test. The items created for the test were analysed and evaluated separately, depending on both the item response theory and the classical item theory. The Cronbach's alpha value calculated for the original test is .68 (Relkin et al., 2020).

Figure 1
Practice Round Questions



Research Purpose

The aim of the present research was to adapt the TechCheck-2 version of the "TechCheck" test developed by Relkin et al. (2020) into Turkish. Within the scope of CT skills, a test adaptation was carried out at the preschool level, which was previously under the umbrella of basic education (Ülker Hançer et al., 2021). However, no measurement tool developed in Turkish at the primary school level was encountered. In today's computer-based society, it is necessary for children to be computer literate as users or creators of digital technology (Bers & Sullivan, 2019). Therefore, the use of a tool with validity and reliability in revealing these skill areas of Turkish children will be beneficial for researchers, teachers, and program development research.

Research Methodology

The TechCheck-2 test developed by Relkin et al. (2020) was adapted into Turkish. In this context, the survey model was used. In the survey model, attempts are made to describe an existing situation (Çepni, 2010), but the causality is not explained (Büyüköztürk et al., 2012). In the present study, researchers tried to reveal an existing situation through a sample taken from the population.

Group

The participants in the study were 2nd- and 3rd-year students studying in Ankara in the 2021-2022 academic year. Relkin et al. (2020) mentioned that the age range in which the TechCheck-2 test can be applied is 7-9. Therefore, for the Turkish adaptation, the study was carried out with primary school students in the same age group. A convenience sampling technique was used to collect the data. The convenience sampling technique is a method that accelerates the research because it allows the researcher to act according to the situation that is close and easy to access (Etikan et al., 2016). In this context, a total of 372 students ($n_{female} = 193$, $n_{male} = 179$) were contacted. While 157 of the students were studying in the 2nd grade, 215 of them were in the 3rd grade ($M_{age} = 7.9$, $SD = 0.718$).

Instruments and Procedures

In this adaptation research, the data were collected with the help of a questionnaire developed by the researchers. In the first part of the relevant questionnaire, the gender, age, and class information of the students were included. The second part of the questionnaire contained the articles of TechCheck-2 translated into Turkish. The final configuration of the questionnaire was delivered to primary school 2nd- and 3rd-grade students through classroom teachers after necessary permissions were obtained. The questionnaire was sent to the students online and the facilities of the schools they studied at were used to fill out the questionnaire.

Ethical Permissions

Within the scope of the research, permission to use the TechCheck-2 test was first requested from the responsible author. The corresponding author asked the purpose of the test, the age group to which it would be applied, and the method to be followed in the analysis of the data and gave permission to use TechCheck-2 for the adaptation research in line with the purpose of this research. In this context, the scoring method of the test, the points to be considered in the application in face-to-face and online environments, the items that make up the test, and the answer key were sent to the researchers via e-mail. After obtaining the adaptation permissions, the form regarding the ethics committee permission, dated 2021 and decision number 573, obtained from the Social and Human Sciences Scientific Research Ethics Committee of Necmettin Erbakan University, was applied to the students who voluntarily agreed to participate in the research.

Test Adaptation Process

After obtaining permission to use the relevant test, the test was first translated into Turkish by the researchers. The translation was sent to three experts along with the original. Two of the experts have very good English language skills and they are faculty members with doctorate degrees. One of the experts is an associate professor who has academic publications on CT skills. The experts compared the translated test with the original version and gave their opinions. For this, they contributed to the adaptation process by filling in the "appropriate, not appropriate, and justification" sections on the form sent to them. The test items translated into Turkish were not retranslated. Visuals are more important than expressions in test items, and expressions for primary school children should be quite clear and unambiguous. Therefore, it was sent to the Turkish teacher, who is doing a doctorate, to check the expressions translated into Turkish in terms of grammar and meaning. After obtaining confirmation about the appropriateness of the expressions in terms of Turkish, the test was administered to two primary school students who were not included in the sample. The aim was to check whether the test items were understood. With the feedback from the students, the test was finalized, and the application form was prepared.

Data Analysis

The CT test is coded as 1-0. Therefore, the item difficulty values (pjx) and item discrimination values (rjx) were calculated for this test. Pjx is a measure of the extent to which the item is answered correctly, and as the obtained value approaches, the item becomes more difficult, and as it approaches 1, the item becomes easier (Tekin, 1991). Rjx, on the other hand, is a measure of how well the items distinguish between those who know and those who do not know about the measured feature. Accordingly, rjx takes a value between -1 and +1 (Turgut, 1992). In the literature (Tekin, 1991; Turgut, 1992), some cut-off points have been reported for pjx and rjx (Table 2). Accordingly, items with a value of .40 and above in terms of discrimination are considered very good, while items with a value of .19 and below are considered very weak. In terms of difficulty, items with a value of .61 and above were reported as easy, and items with a value of .39 and below were reported as difficult. Kuder Richardson-20 and 21 (KR-20/KR-21) coefficients are also used in tests coded as 1-0. These coefficients are used to determine the reliability of the test (Baykul, 2000). The fact that the value obtained in this method is close to 1 indicates that the reliability of the test is also high. A test analysis was conducted in terms of these values suggested in the literature. The data collected from the students were converted into .txt format and analysed with the item analysis program Test Analysis Program (TAP.exe).

Table 2

Evaluation Chart for pjx, rjx, and KR-20

rjx	.40≤ rjx	Very good
	.30 ≤ rjx≤ .39	Quite good
	.20 ≤ rjx≤ .29	Edited and developed
	.19 ≥ rjx	Very weak item should be excluded from testing
*p*jx	.61 ≤ pjx	Easy
	.60 ≤ pjx ≤ .40	Medium
	.39 ≥ pjx	Difficult
KR-20	.00 ≤ KR-20 < .40	Unreliable
	.40 ≤ KR-20 < .60	Low test scores
	.60 ≤ KR-20 < .90	Quite reliable
	.90 ≤ KR-20 < 1.00	Highly reliable

Research Results

The results obtained as a result of the item analysis are presented (Table 3). Accordingly, the minimum score taken from the adapted test is 1 and the maximum score is 15. The mean score of the test is 1 and the skewness and kurtosis values show that the data have a normal distribution (Hair et al., 1998). The score of the discrimination levels of the items in the test shows that the items in the test have a very good item structure (rjx = .458). In addition, it was observed that the items forming the test were at medium difficulty level (*p*jx = .674) and the test was quite reliable (KR-20 = .722). In this context, split-half reliability (.613) and Spearman–Brown coefficients (.760) were found to have very good values. The minimum score obtained by the students (*n* = 127) who responded to the test and were in the upper 27% for the test was 12, and the maximum score obtained by the students in the lower 27% segment was 8. In this way, it is possible to conclude that the test has a valid and reliable structure.

Table 3

Test Analysis Results

Examinee Results		Item Results	
Number of Examinees	372	*p*jx	.674
Total Possible Score	15	rjx	.458
Min Score	1	KR-20	.722
Max Score	15	KR-21	.671
Median Score	10	High Group Min Score (*n* = 127)	12
Mean Score	10	Low Group Max Score (*n* = 106)	8
SD	2.970	Split-Half Reliability	.613
Skewness	-.356	Spearman-Brown Coefficient	.760
Kurtosis	-.299		

The response status of each item forming the test by the students in the lower and upper groups, and the item difficulty and item discrimination scores were discussed (Table 4). Accordingly, it is seen that the items forming the test were answered proportionally by the upper and lower groups, and there was no problematic item. However, it is seen that question number 1 in the test is a very easy item (pjx = .90) and can be edited and improved (rjx = .22).

Table 4
Item Analysis Results

Item	Number Correct	pjx	rjx	Correct in High Group (f / %)	Correct in Low Group (f / %)
Item 1	335	.90	.22	124 (.98)	80 (.75)
Item 2	299	.80	.39	122 (.96)	61 (.58)
Item 3	265	.71	.55	122 (.96)	43 (.41)
Item 4	334	.90	.31	126 (.99)	72 (.68)
Item 5	158	.42	.57	93 (.73)	17 (.16)
Item 6	198	.53	.61	109 (.86)	26 (.25)
Item 7	310	.83	.38	124 (.98)	63 (.59)
Item 8	314	.84	.35	123 (.97)	66 (.62)
Item 9	282	.76	.44	121 (.95)	54 (.51)
Item 10	239	.64	.41	105 (.83)	44 (.42)
Item 11	295	.79	.36	122 (.96)	64 (.60)
Item 12	183	.49	.64	108 (.85)	22 (.21)
Item 13	191	.51	.54	100 (.79)	26 (.25)
Item 14	193	.52	.65	104 (.82)	18 (.17)
Item 15	164	.44	.43	85 (.67)	25 (.24)

Finally, attempts were made to determine the effectiveness of the distracters of the items in the test (Table 5). Accordingly, the total answers given to each question, the answers given by the participants in the lower group, and the answers given by those in the upper group, and the difference between them are shown. When the questions in the test are considered one by one, it is seen that there is no more powerful distracter that can replace the answer key in the analysis made with the TAP.exe program. However, in some questions, it is seen that some options are marked by very few students. For example, 3 chose option A in the 1st question, 9 chose option B in the 3rd question, and 3 chose option C in the 7th question. This shows that these options are not very good distracters. However, this situation did not pose a problem in terms of the answers given by the students in the lower and upper groups to the questions. Considering the response rates given by those in the lower and upper groups to the questions in the test, it is seen that the correct answer option is marked more by those in the upper group. This shows that the questions in the test are appropriate in terms of discrimination.

Table 5
Options Analysis

Item	Group	Option 1 (A) (rjx)	Option 2 (B) (rjx)	Option 3 (C) (rjx)	Option 4 (D) (rjx)
1	Total	3 (.008)	22 (.059)	12 (.032)	335* (.901)
	High	1 (.008)	2 (.016)	0 (.000)	124 (.976)
	Low	2 (.019)	13 (.123)	11 (.104)	80 (.755)
	Difference	-1 (-.011)	-11 (-.104)	-11 (-.104)	44 (.222)
2	Total	51 (.137)	13 (.035)	299*(.804)	9 (.024)
	High	2 (.016)	1 (.008)	122 (.961)	2 (.016)
	Low	27 (.255)	12 (.113)	61 (.575)	6 (.057)
	Difference	-25(-.239)	11(-.105)	61 (.385)	-4(-.041)
3	Total	22 (.059)	9 (.024)	76 (.204)	265*(.712)
	High	0 (.000)	0 (.000)	5 (.039)	122 (.961)
	Low	13 (.123)	6 (.057)	44 (.415)	43 (.406)
	Difference	-13(-.123)	-6(-.057)	-39(-.376)	79 (.555)
4	Total	14 (.038)	16 (.043)	334*(.898)	8 (.022)
	High	0 (.000)	1 (.008)	126 (.992)	0 (.000)
	Low	14 (.132)	13 (.123)	72 (.679)	7 (.066)
	Difference	-14(-.132)	-12(-.115)	-54 (.313)	7(-.066)
5	Total	158*(.425)	51 (.137)	77 (.207)	86 (.231)
	High	93 (.732)	8 (.063)	11 (.087)	15 (.118)
	Low	17 (.160)	16 (.151)	34 (.321)	39 (.368)
	Difference	76 (.572)	-8(-.088)	-23(-.234)	-24(-.250)
6	Total	70 (.188)	88 (.237)	16 (.043)	198*(.532)
	High	3 (.024)	15 (.118)	0 (.000)	109 (.858)
	Low	33 (.311)	37 (.349)	10 (.094)	26 (.245)
	Difference	-30(-.288)	-22(-.231)	-10(-.094)	83 (.613)
7	Total	310*(.833)	6 (.016)	3 (.008)	53 (.142)
	High	124 (.976)	1 (.008)	0 (.000)	2 (.016)
	Low	63 (.594)	4 (.038)	2 (.019)	37 (.349)
	Difference	61 (.382)	-3(-.030)	-2(-.019)	-35(-.333)
8	Total	12 (.032)	35 (.094)	11 (.030)	314*(.844)
	High	1 (.008)	1 (.008)	2 (.016)	123 (.969)
	Low	7 (.066)	29 (.274)	4 (.038)	66 (.623)
	Difference	-6(-.058)	-28(-.266)	-2(-.022)	57 (.346)
9	Total	38 (.102)	282*(.758)	18 (.048)	34 (.091)
	High	3 (.024)	121 (.953)	1 (.008)	2 (.016)
	Low	18 (.170)	54 (.509)	11 (.104)	23 (.217)
	Difference	-15(-.146)	67 (.443)	-10(-.096)	-21(-.201)
10	Total	10 (.027)	239*(.642)	28 (.075)	95 (.255)
	High	0 (.000)	105 (.827)	1 (.008)	21 (.165)
	Low	6 (.057)	44 (.415)	19 (.179)	37 (.349)
	Difference	-6(-.057)	61 (.412)	-18(-.171)	-16(-.184)
11	Total	295*(.793)	29 (.078)	26 (.070)	22 (.059)
	High	122 (.961)	2 (.016)	2 (.016)	1 (.008)
	Low	64 (.604)	15 (.142)	11 (.104)	16 (.151)
	Difference	58 (.357)	-13(-.126)	-9(-.088)	-15(-.143)
12	Total	83 (.223)	183*(.492)	66 (.177)	40 (.108)
	High	6 (.047)	108 (.850)	9 (.071)	4 (.031)
	Low	35 (.330)	22 (.208)	25 (.236)	24 (.226)
	Difference	-29(-.283)	86 (.643)	-16(-.165)	-20(-.195)
13	Total	56 (.151)	66 (.177)	191*(.513)	59 (.159)
	High	5 (.039)	18 (.142)	100 (.787)	4 (.031)
	Low	27 (.255)	22 (.208)	26 (.245)	31 (.292)
	Difference	-22(-.215)	-4(-.066)	74 (.542)	-27(-.261)
14	Total	53 (.142)	94 (.253)	32 (.086)	193*(.519)
	High	8 (.063)	14 (.110)	1 (.008)	104 (.819)
	Low	29 (.274)	41 (.387)	18 (.170)	18 (.170)
	Difference	-21(-.211)	-27(-.277)	-17(-.162)	86 (.649)
15	Total	15 (.040)	164*(.441)	23 (.062)	170 (.457)
	High	1 (.008)	85 (.669)	2 (.016)	39 (.307)
	Low	10 (.094)	25 (.236)	13 (.123)	58 (.547)
	Difference	-9(-.086)	60 (.433)	-11(-.107)	-19(-.240)

**is keyed answer*

Discussion

In the present research, TechCheck-2, a CT test developed by Relkin et al. (2020) for primary school students, was adapted. There are 15 questions in the test and these questions measure the dimensions of algorithmic thinking, modular structure, control structures, representation, software/hardware, and debugging associated with CT. As a result of the statistical analyses conducted, all items in the scale were suitable for inclusion in the Turkish version in accordance with the original scale. The high level of discrimination of the items in the test is an indication that they are successful in distinguishing students with high and low CT skills. In addition, the test contains items of medium difficulty that students of all ability levels can answer. An important condition for a test is that it is a valid and reliable scale in terms of its psychometric properties (Tekin, 1991). It has been determined that the test adapted within the scope of the present research is quite reliable; the KR-20 reliability coefficient was determined as .722. This coefficient is higher than the original scale's KR-20 value. This may be due to cultural conditions. An important issue for tests that measure ability is the comparison of the scores of the students in the lower 27% and upper 27% of the test. The reason for comparing the scores of the students in the 27% percentile is to increase the success differences in the normal distribution and provide sufficient examples for the analysis (Matlock-Hetzel, 1997). The comparison between the lower and upper groups for this test shows that it is reliable in terms of discrimination and that a sufficient sample is included for analysis. The strength of distracters is another important issue in multiple-choice test type scales (Tekin, 1991). In tests containing multiple-choice questions, students are required to choose between answer options, some of which may be partially correct. Partially true or false options are called “distracters” (Gierl et al., 2017) because they give partial information to students and distract the test solver because of the probability of being selected correctly (p.1084). In this test, which was adapted into Turkish, although some of the distracters did not work very well, they successfully distinguished the students who knew from those who did not.

Conclusions and Implications

As a result, it is possible to conclude that TechCheck-2, which has been adapted into Turkish, is a very valid and reliable tool to objectively measure children's CT skills. Tang et al. (2020) stated that most of the measurement tools for CT include items on specific topics such as computer science or coding; therefore, there is a need for tools measuring this skill in general. The adapted TechCheck-2 can be used for general evaluation as it contains items independent of the subject area. Measuring CT skills with valid and reliable tools suitable for primary school students will enable the students to reveal their potential in this field, and it can also be used as a pre-test/post-test measurement tool in determining how effective the research and educational content for primary school students is. By determining which dimensions of students' skills are open to improvement within the scores to be obtained from this test, the relevant skill can be supported. It can also be useful for identifying students who need extra support and have special difficulties (Relkin et al., 2020). In addition, the relationships between students' literacy skills and CT skills can be revealed with this test. The present research was limited to the students who participated in the test application from the province of Ankara. In future, a wider sample can be included by collecting data from students from different provinces in Turkey. Thus, the CT development of Turkish students can be discussed by using it in both survey and experimental research.

Ethical Approval

Ethical approval for the research written permission was also granted by the Ethics Committee of Necmettin Erbakan University (Decision No: 2021/573).

Declaration of Interest

The authors declare no competing interest.

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THE IMPLEMENTATIONS OF PRIMARY SCHOOL TEACHERS ABOUT THE CONCEPT OF DIGITAL CITIZENSHIP

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Abstract

The current study seeks to explore primary school teachers' implementations of the concept of digital citizenship. The study adopted a questionnaire as the quantitative method and distributed it to the participants online. 943 participants were both (female, male) of Hail city in Saudi Araba. The results show that the primary teachers have positive implementations about the concept of digital citizenship and its dimensions. It also found that tender had no effect on digital citizenship dimensions. However, primary teachers with more than 10 years of technological experience high higha level of knowledge of concept of digital citizenship, especially in digital communication and digital etiquette.

Based on the findings, the study recommended focusing on developing the capabilities of educational cadres in general and teachers in particular, as well as preparing and training them in the areas of digital citizenship, allowing them to teach it effectively and to effectively employ digital technologies in the educational process. More research is needed in the future to identify the requirements for citizenship in education from the set of cultural, social, health, legal, and security determinants related to digital technology that enable the educational system in general, and teachers in particular, to contribute to the preparation of a modern citizen capable of using and employing digital technology in a safe and sound manner.

Keywords: *descriptive research, digital citizenship (dc), education system, primary school teachers*

Introduction

Today, the entire world is experiencing a great scientific renaissance and progress in the field of information and communication technology. There is a diversity of electronic applications that have become accessible to people, which has been known as the digital revolution. Mahdi (2018) stated that with the emergence of this revolution, the individual's use of applications is no longer confined to a specific site or email, but rather his or her use of it has been part of the daily life such as communication, information exchange, entertainment, public services, commerce, health, and education. Although this technological progress and the many benefits it provides to individuals, many issues may negatively affect them if they are not considered (Al-Abdullatif & Gameil, 2020).

One of the most serious issues that people face when using the internet is online security, which includes identity theft, fraud, and hacking; information misuse, such as plagiarism and unauthorized access to protected content; and health risks, such as eye damage from prolonged screen exposure and internet addiction. Therefore, there is a clear need to educate the community and educators about the risk and misuse of the internet and how to deal with it, which will certainly contribute to educating their students, helping them to how protect from these dangers while using them and the benefit from the advantages of the internet. From this standpoint, the term Digital Citizenship (DC) has emerged to spread its culture at home among family members and at school among teachers and students. In the context of current scientific

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developments and their challenges to raise a generation that leads a culture of knowledge and learning in a safe environment, DC has become an urgent necessity and a necessary requirement (Alhosary, 2016; Alselehat, & Alsarhan, 2018).

Studies pointed that developed countries, such as UK, USA, and Canada, have designed special curricular of DC that is currently taught in all schools, which aims to spread the culture DC among both students and teachers (Al-Abdullatif & Gameil, 2020; Mahdi, 2018; Djudin & Kartono, 2022). However, since the Kingdom of Saudi Arabia (KSA) is a developing country, there have been few studies on how well individuals, particularly teachers, understand the concept of Digital Citizenship. As a result, the current study investigates the issue more thoroughly in a different context, namely Saudi Arabia, which has adopted an e-learning environment in its learning, particularly in primary and kindergarten, during the pandemic period.

Research Problem

With the corona pandemic's emergence, internet use has become mandatory among people (Akcıl &Bastas, 2020). People do not use the internet only for communication purposes, but rather they use it for shopping, work, meeting, and education. Previous studies, such as Ranchordas's study conducted in 2020, stated that individuals at this time have been more careful in communicating and their relationships with others have shifted from offline to online. According to Yolal and Kozak (2008), internet users can meet their needs through the electronic environment. As a result of technological advancement and the increasing use of technology among individuals, technology and its applications have become a part of human life, resulting in the emergence of a new dimension to human relations and communication, which has been referred to as a new societal concept, whose members are known as digital citizens (Castells, 2000).

Ribble (2008, p.15) defined DC as "the norms of appropriate, responsible behavior with regard to technology use". It briefly means smart dealing with technology. DC should not be understood by users as aiming to set up borders and obstacles for control and tyranny against users in contravention of the values of freedom and human rights. It seeks to find the best way to guide and protect all users, particularly children and adolescents, in the digital world by encouraging desirable behaviors and combating unwanted behaviors (Al-Abdullatif & Gameil, 2020). In addition, Almeslemani (2014) described DC as practices that aim to empower teachers, students, and parents to use technology safely and effectively.

DC includes rules and standards that aim to create a society capable of using technology responsibly. Several studies, such as Djudin and Kartono (2022); Al-Abdullatif and Gameil (2020) and Ruby (2020), declared that DC is an upgraded version of traditional citizenship that requires belonging to society, achieving its goals, and adhering to its social, economic, and political laws. As a result, users in general, and students and teachers in particular, benefit from DC by dealing with rights and duties that contribute to the nation's and citizen's progress.

According to Al-Abdullatif and Gameil (2020), not only the citizen in the traditional context must learn how to be a conservative citizen in order to develop the society for better, but the citizen in the digital world also must learn and understand the ethics of this context to have insight about his/ her rights and protect her/himself from the damages that may be inflicted. According to Alqahtani et al. (2017), a digital citizen is someone who can improve skills and behaviors that promote positive interactions with others in the digital world. Çubukcu and Bayzan (2013) argued that digital citizens can use and employ digital technology in a good way and in accordance with behavioral, ethical, religious, and legal rules. They explained that digital citizens are able to use technology without harming others who use this environment and benefit from electronic communication and learning. According to Ribble (2008), the digital citizen possesses characteristics that set him or her apart from others, including confidence and ability to use technology; use of technology to participate in educational, cultural, and economic activities; use of critical thinking skills in cyberspace; use of technology to connect with others in positive ways; and respect for the concepts of privacy and freedom of expression in the digital world; a sense of responsibility towards continuous learning; and contributing to effectively promoting the values of digital citizenship. Ohler (2010) added that the digital citizen could manage his/her actions, know the right way to access the information wants, and be aware of the risks associated with the bad use of this context.

The concept of DC has been associated with the education system because it has undoubtedly contributed to the understanding of what students must know in order to use technology properly by both teachers and parents. The aim of DC is to prepare students for participation in society and active participation in serving the nation through the digital world (Başarmak, et al. 2019). Al-Abdullatif & Gameil (2020) showed that educational institutions must spread the culture of DC among the students to actually enhance the protection of the society from the increasing negative effects of technology and promote the optimal use of it to contribute to the development of the knowledge and building the national digital economy.

Park (2016) argued that teachers should contribute to providing students with important skills and knowledge in the digital citizenship. For example, digital citizen identity refers to the ability to create and manage a healthy online identity; screen time management refers to the ability to manage screen time, multitask, and engage in social media responsibly. Cyberbullying management entails the ability to handle and detect cyberbullying cases as well as deal with them wisely; management of cyber security, which means the ability to manage various cyber-attacks and protect person's data by creating strong passwords; privacy management, which means the ability to protect the privacy of others and all personal information shared over the Internet; critical thinking, which means the ability to differentiate between true and false information, good and harmful content, reliable and suspicious online communications; digital empathy, which means the ability to understand the needs and feelings of others online and empathize towards them; and digital footprints, which means the ability to understand and manage responsibly the real world implications of digital footprints.

Most previous studies conducted in the field of DC focused on the digital citizen and the extent of his/ her knowledge of the aspects of privacy, security, ease of access to information through technology as well as the health and moral aspects. For example, Suson (2019), through research on the issue of the awareness of teachers and students of the concept of DC and its elements, found that both teachers and students had awareness of its meaning and its elements, but in a level lower than average. He added that the participants' awareness of the digital law was higher compared to the extent of their awareness of their digital rights and duties, which means that the participants are not prepared to know their rights, duties, and their responsibility in digital world.

Furthermore, Mahrous (2018) conducted a study on the level of knowledge of kindergarten teachers in the KSA in the dimensions of digital citizenship, which revealed a significant lack of knowledge about digital citizenship among kindergarten teachers. Therefore, it is recommended providing teachers with training courses related to digital citizenship. In addition, Alselehat et al. (2018) discovered that students had an average level of awareness of the concept of DC and elements of DC among undergraduate students in the Faculty of Educational Sciences at the University of Jordan. They recommended that students do need a training course from teachers and institutions to increase the level of their awareness and educate them about the concept of digital citizenship. Also, Netwong (2013) studied the relationship between DC and learning success in the field of information technology. The findings revealed that through e-learning, their awareness of DC increased by 15.85%, while their rate of learning success increased by 23.37%, indicating a strong relationship between DC and learning success. Jones and Mitchell (2016) discovered that young users exhibited less respectful online behavior and females were more aware of DC than males when they developed a DC scale for the online civil participation dimensions as well as respectful online behavior.

Although there are many studies, such as Ata & Yildirim (2019); Mahdi (2018); and Alsuhaim & Alibrahim (2019) conducted to measure the extent of students' awareness of the concept of DC, few studies have been concerned with knowing the degree of awareness of the concept and its elements among teachers particularly in Saudi context. Because the researcher believes that correctly educating school students about the concept of DC necessitates first raising the level of teachers' understanding of the concept of DC and the importance of acquiring basic technological skills among primary school teachers' implementations. As a result, the current study sought to investigate primary school teachers' perspectives on the concept of DC. The study sought to answer the following questions:

1. What are the primary school teachers' implementations about the concept of DC?
2. Is there any difference in the dimension of the DC among primary school teachers' implementations by gender?
3. Is there any difference in the dimension of the DC among primary school teachers' implementations by extent of experience in using technology?

Theoretical Background

As the aim of DC is to contribute to the preparation of the modern citizen in the ability to use digital technology properly and safely, and to give the citizen necessary skills that help in protecting them from digital dangers, Digital citizenship has nine dimensions (Ribble et al. 2004; Ruby & Li, 2020; Djudin & Kartono, 2022): digital access, digital commerce, digital communication, digital literacy, digital etiquette, digital laws, digital rights and responsibilities, digital health and safety, and digital security. Since the current study explores the implementations of primary teachers about the concept of digital citizenship, the researcher focuses on five dimensions, which are as follows:

- **Digital communication:** it has become the new means by which people interact with each other, whether it is through social networking sites, such as Facebook or Twitter, and other digital means of communication, such as email or others. As a result, it is necessary to educate digital citizens in order to achieve appropriate digital social communication when communicating with others, as well as educate digital users in terms of etiquette and rules to follow (Almallah, 2017).
- **Digital etiquette:** It is the standards of behavior or procedure that other users of digital technology expect, according to Almallah (2017). In fact, most digital users do not learn digital etiquette before using technology. Almallah added that, while some policies in technology have been implemented, there is a great need for parents to educate users, particularly digital youngers, on how to deal with technology. However, Ruby (2020) argued that with technological development no longer education is the responsibility of parents only, but also teachers have a big role in dealing with digital behavior issues and emphasizing the recognition of the basics of digital rules of behavior, which is based on the principle of respect.
- **Digital health and safety:** It refers to the ability to maintain mental and physical health while using digital technology. Digital users must be made aware of the importance of taking health precautions, as well as the inherent physical and psychological risks and negative effects that can occur when using technology and its resources for extended periods of time. Digital users must reconcile between their use of technology in a responsible way and maintaining their good health.
- **Digital laws:** It refers to how well digital users understand the legal rights and constraints that govern their use of technology. It was created under the name of the

Anti-Cybercrime Law to protect digital users all over the world, and any violation of the laws of this system carries serious consequences. So, this issue must be addressed, through awareness and clarification of the penalties that result from irresponsible behavior of some users, such as: using hacking programs, illegally downloading their files, disseminating destructive viruses or spyware, sexual harassment, or identity theft.

- **Critical thinking dimension:** It refers to users' ability to effectively use technology. Regardless of the efforts made to spread technology in general, it is necessary to understand how to use and benefit from technological resources, not just how to use them appropriately. Learning digital basics, evaluating electronic resources and the accuracy and truthfulness of their content, and detecting and developing patterns of online learning and distance learning are all critical issues in digital culture.

Even though the International Association for Technology in Education (ISTE) has established standards for the appropriate use of technology that teachers and students must follow, no specific behaviors were agreed upon when using technology (Shehatah, 2013). Therefore, the current study sheds the light on five dimensions that seem to be more important than others in Saudi context and unclear among Saudi digital users at the same time.

Research Methodology

General Background

Since the current study is descriptive in nature, a questionnaire was used to answer the study questions. The questionnaire was adopted from the previous studies (Ribble, et al. 2004; Alselehat; Ruby & Li, 2020; Djudin & Kartono, 2022), and it contains two parts. First part: general demographic information such as their age, academic majors, and level of technology experience. Second part: teachers' implementations on DC scale: it has 25 items digital citizenships scale that was applicable for primary school teachers. It consisted of five dimensions: digital communication (items from 1 to 5), digital etiquette (items from 6 to 10), digital health and safety (items from 11 to 16), critical thinking (items from 17 to 22), and digital law (items from 23 to 25). Responding to the items according to a 5-point Likert scale from 'strongly disagree' to 'strongly agree'.

Participants

Regarding to the participants, the study included 943 participants from Hail city in Saudi Arabia. The sample was selected as available, and the reason behind choosing primary school teachers as the sample of the study is that education in KSA (Primary school teachers were chosen because of their significant influence on students' attitudes at this age), especially for this stage, continued from a distance through e-platforms for a longer period. The demographic variables were shown as in Table 1.

Table 1
The Demographic Variables Descriptive Analysis

Variable	Levels	Frequency	Percent %
Gender	Males	71	7.5
	Females	854	90.6
	Missing	8	1.9
Age	26 y – 35 y	158	16.8
	36 y – 46 y	544	57.7
	37 or more	217	23
	Missing	24	2.5
Experience years	Less than 5y	173	18.3
	6 y – 10 y	269	28.5
	More than 10 y	478	50.7
	Missing	23	2.4
Usage objectives	Educational	550	58.3
	Snss	176	18.7
	Researching data	164	17.4
	Enjoyment	29	3.1
	Missing	24	2.5
Login types	PC	367	38.9
	Smart phone	450	47.7
	Projector	24	2.5
	Tablets	66	7
	Smartboard	10	1.1
	Missing	26	2.8

Instrument

The questionnaire was sent to experts in the field to verify its validity. The experts checked the questionnaire and all its items and ensured the accuracy of the language. The researcher made the required modifications to the questionnaire before sending it to the participants. Regarding to the reliability of the questionnaire, it was calculated using Cronbach's alpha. The internal consistency by Cronbach's alpha was 0.873, which indicates the high reliability of the questionnaire. The mean score of the scale was 95.66 and the standard deviation 11.50 degree. The 5-point Likert scale was selected for scale responses. The total degree was ranged from 25 to 125 degrees.

Data Analysis

Regarding Data analyses, IBM SPSS v.21 statistical software was used to examine the data and perform statistical analysis of inferential tests to verify the study hypotheses. Descriptive statistics indicators such as mean, median, standard deviation, skewness and kurtosis coefficients were calculated for the dimensions. The linear normality of the data and the boxplots were performed to examine the dimensions data of outliers. Data dimensions were transformed using standardized data. Internal consistency was calculated using Cronbach's alpha coefficient. Lisrel software version 8.7 was used to verify the construct validity. The study depended on the RMSEA, χ^2/df, SRMR, NNFI, GFI and AGFI indices.

Research Results

Descriptive Results

Some descriptive indicators were computed to test the existence of teachers' perceptions on DC scale. The descriptive indicators as in table 2.

Table 2
The DC Dimension Descriptive Statistics

	Digital Communication	Digital Etiquette	Digital Health and Safety	Critical thinking	Digital law
Mean	18.96	20.80	24.18	17.69	13.35
Median	20	21	24	18	14
σ^2	12.94	16.93	17.92	22.18	1.87
Skewness	-.90	-1.24	-1.08	.15	-1.01
Kurtosis	2	1.60	2.39	-.04	.47
Cronbach's alpha	.820	.820	.876	.838	.879

From table 2, the mean for DC dimensions ranged from (Digital Health and Safety; 24.18, Digital Etiquette; 20.80, Digital Communication; 18.96, Critical thinking, 17.69) to Digital law; 13.35. This indicates that the primary teachers have positive implementations about the concept of DC.

Also, the dimensions had strong consistency by alpha coefficients: digital communication (α =.82), digital etiquette (α =.82), digital health and safety (α =.88), critical thinking (α =.84), and digital law (α =.88).

Linear normality: The Kolmogorov-Smirnov test was used to determine the presence of linear normality. Digital communication dimension has no normality (statistics = 0.12, $p < 0.05$), Digital etiquette dimension has no normality (statistics = .15, $p < 0.05$), Digital health and safety dimension has no normality (statistics = 0.14, $p < 0.05$), critical thinking dimension has no normality (statistics = 0.09, $p < 0.05$), and Digital law dimension has no normality (statistics = 0.24, $p < 0.05$).

Outliers: Using the boxplot to study data dimension outliers. The outliers were as follows:

Figure 1
Outliers of DC Dimensions

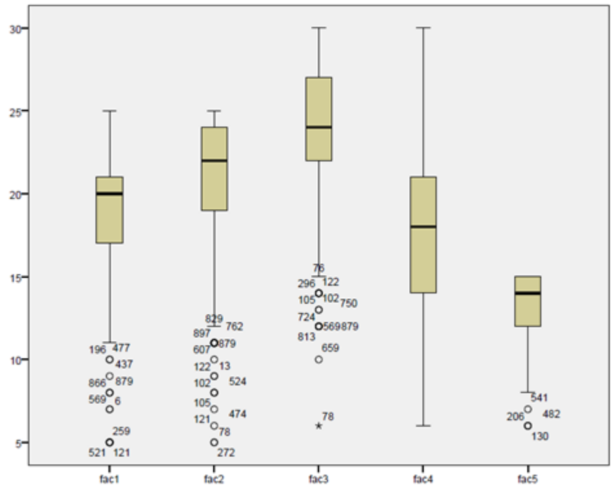

Figure 1. cleared that there are negative outlier values in four dimensions. To get rid of the outlier cases, the data was transformed into standardized data.

Construct Validity

Confirmatory factor analysis was performed to verify the construct validity. The maximum likelihood method was selected in data analysis. The goodness-of-fit were: RMSEA= .086, $\chi^2/df = 6.8$, NNFI = .94, GFI = .95, SRMR = .075, and AGFI = .81. the indices were accepted according to sample data. The index of χ^2/df has badly fitted index. The factor items are as in table 3.

Table 3
The DC Dimensions Item Factor

Dimensions	No.	Items	Loadings	SE	*t*-values
Digital Communication	1	I use ICTs to communicate with others and share ideas.	.79	.029	26.99
	2	I communicate with others through digital social media.	.80	.029	27.38
	3	In my online interactions, I frequently share audio and video clips.	.58	.032	18.20
	4	I use the Internet to assist with activities both inside and outside of school.	.72	.030	23.66
	5	I communicate with others via email.	.54	.032	16.57

https://doi.org/10.33225/pec/22.80.777

Digital Etiquette	6	I never share any of my personal information on social media or other ICTs.	.47	.033	14.41
	7	I follow the rules of polite dialogue and conversation when using various ICTs.	.79	.029	27.63
	8	I block accounts with inappropriate messages (e.g., in relation to morality, religion, or public taste).	.74	.030	24.98
	9	I do not use ICTs to exchange offensive digital content.	.77	.029	26.73
	10	In my use of various ICTs, I respect others' views and opinions and accept people's differences.	.73	.030	24.72
Digital Health and Safety	11	I am aware of the physical consequences of long-term use of ICTs.	.60	.031	19.12
	12	I understand the dangers of ICT addiction and how to mitigate its effects.	.66	.030	21.88
	13	I commit to using digital devices only at certain times of the day.	.74	.029	25.34
	14	When using a computer or mobile device, I use the appropriate settings.	.80	.028	28.51
	15	I make certain that the lighting on the computer screen and in the workplace is adequate to reduce eyestrain.	.78	.029	27.13
	16	While working on the computer or other digital devices, I take breaks and exercise.	.66	.030	21.71
Critical thinking	17	The internet is a reliable source of information on economic, political, and social issues.	.60	.032	18.85
	18	I participate in campaigns on digital platforms after conducting extensive research.	.64	.032	20.17
	19	On the Internet, I criticize issues that I believe are unjust.	.66	.031	21.13
	20	Without hesitation, I accept the accuracy of the information I read digitally.	.78	.030	26.35
	21	Shares of my friends are reliable for me	.71	.031	23.11
	22	The information I read on digital platforms influences my daily thoughts and decisions.	.65	.031	20.74
Digital law	23	I respect others' rights on the Internet and do not violate them.	.83	.028	30
	24	I do not use hacking software or steal the identities or private information of others.	.86	.027	31.33
	25	When I use digital material from others, I follow electronic licenses and copyright rules and acknowledge their work.	.84	.028	30.28

The digital communication dimension factor ranged from .52 to .80. Then, the digital etiquette dimension ranged from .47 to .79. whereas the digital health and safety dimension ranged from .60 to .80. Critical thinking dimension ranged from .60 to .78. Finally, Digital law ranged from .83 to .86.

This means that the dimensions of the DC scale affect the research sample, so their familiarity and influence begin with the dimension of the most digital communications axis, followed by the dimension of digital etiquette, then the dimension of health and security, then the dimension of critical thinking, and finally the dimension of digital law.

The Differences in Teachers' Implementations on DC Dimensions Across Gender

Standardized data was used in analyses after dimensions data transformation. The independent sample t-test was used to examine gender differences in data. The results are as in Table 4.

Table 4
The Differences in DC Dimensions Across Gender

Dimensions	Gender	*N*	mu	*SD*	t-value	*df*	*p*
Digital Communication	Males	68	.117	1.18	1.005	907	.315 No sig.
	Females	841	-.009	.98			
Digital Etiquette	Males	69	-.08	.96	.677	912	.499 No sig.
	Females	845	.006	1.003			
Digital Health and Safety	Males	69	-.214	.97	1.846	903	.065 No sig.
	Females	836	.016	1			
Critical thinking	Males	69	-.14	.95	1.223	887	.222 No sig.
	Females	820	.012	1.004			
Digital law	Males	68	-.172	1.110	1.474	859	.141 No sig.
	Females	793	.013	.99			

The results revealed that gender has no effect on DC dimensions.

The Differences in Teachers' Implementations on DC Dimensions Across Experience Years

After dimensions data processing, standardized data was used in analyses. One ANOVA was performed to test the differences in teachers' experience years data. The results are as in Table 5.

Table 5
The Differences in DC Dimensions across Experience

Dimensions	Variance source	*SS*	*df*	*MS*	*F*	*p*
Digital Communication	Between	19.42	2	9.71	9.91	< 0.001 Sig.
	Within	882.98	901	.98		
	Total	902.40	903			
Digital Etiquette	Between	7.34	2	3.67	3.69	.025 Sig.
	Within	902.14	906	.99		
	Total	909.48	908			
Digital Health and Safety	Between	4.01	2	2.01	2.01	.134 No Sig.
	Within	894.66	897	.99		
	Total	898.68	899			
Critical thinking	Between	.10	2	.05	.05	.950 No Sig.
	Within	887.45	881	1.01		
	Total	887.55	883			
Digital law	Between	4.79	2	2.40	2.40	.091 No Sig.
	Within	851.54	853	.99		
	Total	856.33	855			

The results revealed that there were effects in digital communication and digital etiquette dimensions across teachers' experiences. The experience years have no effect on digital health and safety, critical thinking, and digital law.

The post hoc analysis was performed for the digital communication and digital etiquette dimensions as in table 6.

Table 6
Post Hoc Analysis of Experience Years Levels in Digital Communication Dimension

Dependent variable	Experience	*(J) experience*	*Mean difference*	*p*
Digital Communication	Less than 5 y	6y – 10y	-.107	.514
		More than 10 y	-.349	.0001
	6y – 10y	More than 10 y	-.242	.004

There were statistically significant differences between the level of less than five years and the level of more than 10y. The differences were in favor of the level of more than 10y. Then, there were statistically significant differences between the level of 6y. – 10y. and the level of more than 10y. The differences were in favor of the level of more than 10y.

Table 7

Post Hoc Analysis of Experience Years Levels in Digital Etiquette Dimension

Dependent variable	experience	(J) experience	Mean difference	*p*
Digital Etiquette	Less than 5 y	6y – 10y	-.179	.162
		More than 10 y	-.242	.018
	6y – 10y	More than 10 y	-.064	.683

There were statistical significance differences between the level of less than 10 years and the level of more than 10y. The differences were in favor of the level more than 10y.

Discussion

According to the findings, the primary teachers had positive implementations about the concept of DC. The first reason behind this might be the high ability of participants to integrate DC and its dimensions; which are communication, etiquette, health and safety, critical thinking, and law; into technology; The second reason behind this might lie in the positive attitudes of participants about technology and their use in the teaching and learning process. This result corresponds to the findings of the study conducted by Ata and Yldrm (2019), who discovered that participant pre-service teachers had positive attitudes toward digital citizenship. The result also shows that the participants have a high awareness of the concept of DC particularly with digital health and safety and digital etiquette. This is the same as what was confirmed by Walters et al. (2019); Peart et al. (2020). The results show that participants are aware of the physical effects of sustained use of ICTs. I may argue that this indicates their clear concern for their health and high realization of the risks that technology might present on their health in the long term.

This finding concurs with the research results of Al-Abdullatif and Gameil's study (2020). In terms of digital etiquette, participants stated that they do not share personal information on social media, that they block accounts that contain inappropriate messages, that they respect the views and opinions of others, and that they accept people's differences. It might be due to the role of educational institutions, especially during the period of the Corona pandemic, in providing educational courses for teachers about the concept of DC to spread the sufficient awareness of digital etiquette to reduce cybercrime and others (Fernández-Prados, et al. 2021). The findings contradict the findings of Tangül and Soykan's (2021) and Domingo and Guerrero's (2018) studies, which found that classroom teachers and candidate classroom teachers lacked knowledge of digital ethics and needed training. The inconsistency in the results of the current and previous study might be due to the courses that were provided by the ministry of education and educational institutions. In KSA has introduced many courses of digital ethics during the pandemic for all classes of society, especially the educational community.

Furthermore, the results revealed that female primary teachers have the same perception about the concept of DC and its dimensions as male primary teachers. This may be attributed to the great developments in the KSA and the vision 2030, which interests significantly in educating teachers, regardless of their gender. The result is in accordance with the study of Djudin and Kartono (2022); Buchholz, et al. 2020, which found that gender does not have effect on the concept of DC and its dimensions. The findings also showed that primary teachers with more than 10y of technological experience have high level of knowledge of the concept of digital citizenship, especially with digital communication and digital etiquette. This may be due to their long and effective use of technology, which has in turn contributed to the development of the concept of DC and their proper understanding of it. The result is in accordance with the study of Guillén-Gámez, et al. (2021).

The findings support the previous research that the COVID-19 crisis provides an opportunity to reflect deeply on what it means to be a "good [digital] citizen. [now by] participating[ing] in civil and political life, critique[ing] global problems, and ameliorat[ing] them through hopeful inquiry and action" (Stitzlein, 2020; Buchholz, et al. 2020). It is critical to be prepared for the possibility of additional crises in the near future (Fernández-Prados, et al. 2021).

Conclusions and Recommendations

This study concludes that the primary teachers in KSA have positive implementations about the concept of DC and its dimensions. It reveals that gender has no effect on DC dimensions. However, primary teachers with more than 10y of technological experience have high level of knowledge of the concept of digital citizenship, especially with digital communication and digital etiquette. To increase the reliability of the study, it is necessary to apply the study to students to have more insight about the issue.

The concept of DC is closely related to educational systems because it assists teachers in understanding what a student must know to successfully use technology. DC is more than just an educational tool; it is a method of preparing students to contribute effectively to society while also participating safely in the digital environment. We need learners who are equipped with a critical and creative mindset to deal with all forms of technology that exist and will emerge in the future. We want to create a digital society that embodies civic values. Modern trends of information technology education should focus on the importance of developing the capabilities of educational cadres in general and teachers and preparing them well and training them in the areas of digital citizenship, allowing them to teach it in the best way and to effectively employ digital technologies in the educational process.

Educational leaders, such as policymakers, researchers, and teachers, would be wise to take a holistic approach as they develop policies and procedures to ensure healthy, active, and productive–yet safe–use of the Internet and related tools in educational settings. Because external, i.e., out-of-school, interactions shape so much of today's students' digital experiences, so should the solutions. In other words, as we work to develop positive and productive solutions, we should strive to include as many key members and stakeholders who share in – and benefit from – students' digital lives as possible, from families to law enforcement, from telecommunications organizations to local, provincial, and national leaders.

More future research is needed to identify the requirements for citizenship in education from the set of cultural, social, health, legal and security determinants related to digital technology that enable the educational system in general, and the teacher in particular to contribute to the preparation of a modern citizen capable of using and employing digital technology in safe and sound way. Also, studying the challenges facing Saudi schools in trying to instill the values of citizenship among their students and ways to deal with them. In addition, Future research should concentrate on what is unique to the concept of digital citizenship: "critical awareness" and "digital activism," as other conceptual categories and measurement tools, such as "digital literacy" or "digital competence," address the other dimensions.

Limitations

The results suffer from a Type I error in the generalizability of the results because of the disparity of the participant sample size in gender. The female sample was much larger than the male participants, which indicates the biased decision in favor of females.

Some demographic variables were excluded from the analysis, due to the varying sample sizes, which makes the decision taken according to the results inaccurate concerning the use of the objectives of using the Internet, and the age level to which be selected, as the participants' selection was available sample by the researcher, and accordingly, making a decision regarding generalization of the results gives Type II error.

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THE OPINIONS AND NEEDS OF SCIENCE CENTER INSTRUCTORS: THE CASE OF GOKMEN SPACE AND AVIATION TRAINING CENTER (GUHEM)

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Abstract

This study aimed to examine the opinions of the instructors who work at GUHEM (Gökmen Space and Aviation Training Center) on the exhibition's content, how the exhibition spaces contribute to science education, especially astronomy and aviation, and the types of visitors who frequently visit the center. Nine instructors from GUHEM's science centers participated in the study. Data were gathered using the "Instructor Opinion Form," with nine open-ended questions. The data elicited from these questions were subjected to content analysis. The findings showed that children aged 6 to 11 made up the majority of visitors; the fascinating exhibition areas focused on the Solar System and planets and interactive workshops with space and aviation themes, like those involving paper airplane construction and rocket competition, were very popular. In terms of the contribution of this center to science education, it was found that the GUHEM exhibitions played an active role in teaching the solar system, planets, and pressure. Although astronomy is the discipline with which the exhibition areas are most closely associated, it can also be linked to other disciplines like astrobiology, mathematics, and aviation. Instructors shared their worries that they won't be able to meet visitors' expectations and occasionally struggle to understand the subject during activities held at GUHEM. These findings led to the opinion that GUHEM and other science centers will function more effectively if schools and science centers collaborate more, the curriculum and exhibition content are improved, and the instructors receive professional assistance from academicians who are subject-matter experts.

Keywords: *astronomy and aviation, instructor, needs, opinion, science center*

Introduction

Nowadays, science education techniques must include a pedagogical and technical approach that blurs the lines between schools and science centers, including students and teachers. Science is mainly carried out in three types of learning environments. Classroom, laboratory, and out-of-school learning environments are examples of these environments. Among the most effective learning strategies is one in which students take an active role in their learning, learn by doing, associate the subjects they study with their environment, and connect with their social lives. Out-of-school learning environments (OSLEs) are at the forefront of where this understanding can be most effectively implemented (Eshach, 2007; Falk et al., 2007). Museums, aquariums, botanical gardens, zoos, and science centers, as well as visits to the natural environment, can help students appreciate the lessons presented in the classroom (Bozdoğan, 2007; Sturm & Bogner, 2010). OSLEs provide students with unique, interesting science learning experiences and various science teaching tools for classroom teachers. It is now widely acknowledged that critical thinking and creativity, as well as problem-solving, communication, digital, social, intercultural, and linguistic skills, are required for students to understand and act in society in an informed and reflective manner (Baptista, 2017). It is not

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sufficient to teach students scientific concepts, theories, and facts in order to develop their competencies. It will also be necessary to create learning situations that promote competency development. Science teaching has been liberated from one-way information transfer processes (stagnant structures) by new teaching strategies and transformed into a structure that activates students' science process skills (problem-solving, observation, deduction, etc.) (Gülçiçek & Güneş, 2004). As a result, such situations must appeal to and are relevant to students by making sense to them and involving them in their learning. Science educators must thoroughly understand how people learn science and the skills and dispositions necessary to promote meaningful learning at their individual levels of science teaching (Lamanauskas, 2012). In this context, there is a need for environments that will facilitate the science teaching process of educators and encourage individuals to learn science. One of the most popular of these environments is science centers.

Science centers, a type of OSLE, play a significant role in science education. Most studies demonstrate that science museums and centers play an essential role in science education in OSLEs (Bell et al., 2010; Stocklmayer et al., 2010). Science center visits in science education allow students to learn deeper and have more permanent information through experiments and demonstrations, use the scientific method, and gain scientific research skills (Griffin, 1998). Science centers increase students' interest in science and math in all aspects and enhance their attitudes, particularly when implementing what they have learned in school (Sample McMeeking et al., 2016; Şentürk & Özdemir, 2014). Slabeycius and Polčin (2012) discussed techniques for engaging primary and secondary school students in math and physics. They claimed that information and communication technologies are one of these methods. They also said that initiatives to increase the use of information and communication technologies can support this process. In this case, due to its technical infrastructure, science centers are believed to support the teaching of other subjects as well, including mathematics, geography, and especially science. Visits to science centers can also positively impact students with other science-related activities, such as watching TV documentaries, reading books, conducting research, experimenting, and deciding to become a scientist as a career (Alexander et al., 2012; Falk et al., 2007). Traditional science center/museum activities have begun to lose their former popularity due to growing Internet usage. Instead, the desire to give visitors a more interactive experience has been felt. As a result, exhibitions and fixed interactive activities focusing on students' excitement for 1-2 seconds have begun to be replaced by activities based on doing and understanding that can pique visitors' long-term interest. Practical interactive scientific activities have become standard at the majority of science centers in both developed and developing countries (Turkish Academy of Sciences, 2019).

One of the essential goals of science centers is to instill a love of scientific discoveries in students, educate them about the history of scientific breakthroughs, and motivate them to make their own scientific discoveries (Falk & Storksdieck, 2005). However, in recent years, these objectives of science centers have come under fire. The arguments are that it is impossible to make students love science by focusing solely on the entertainment aspect of the job and that students can't develop a long-term interest in scientific-related disciplines by focusing only on short-term enjoyable activities.

The complexity of scientific inventions and technological developments, which are difficult for ordinary citizens to understand, can be more understandable and concrete by revealing the relationship of concepts with daily life and nature. Therefore, science centers are becoming increasingly important in science education (Falk & Needham, 2011; Galanis et al., 2016). The exhibitions in science centers must be compatible with scientific reality, as well as the architectural beauty of the center for a good psychological experience, its acoustic layout, and its pedagogical features for effective learning space and experience, for this effect to occur on visitors (Koster, 1999; Gürsoy, 2022). Without these features, science centers will struggle to provide a good experience for visitors.

Science centers are expected to actively monitor breakthroughs in fields other than mathematics, science, and engineering and to hold exhibitions and workshops in these areas. When designing concepts for new science centers, the capabilities of current science centers to minimize repetition should be evaluated. Furthermore, the number of activities in science centers should be increased and varied and replaced regularly. Moreover, science centers should emphasize teacher education, particularly in the field of basic sciences, and develop unique programs within this framework. Since exhibition designs wear out after a certain period and their renewal imposes a significant financial burden, it is suggested that instructional programs (science workshops, laboratories) should be prioritized at science centers. On the other hand, employees working in science centers must be scientifically competent to explain science accurately and endear it to pupils. As a result, postgraduate and doctoral graduates should be favored for employment at these centers, and attractive and flexible working circumstances should be provided (Turkish Academy of Sciences, 2019).

When the characteristics of science centers were evaluated, it was noticed that the instructors working at the science center, as well as the physical qualities and exhibition places, should be qualified individuals in their profession. Visitors to science centers regard educators as the most knowledgeable (Gomes da Costa, 2005) and serve as the human contact between science and society (Iuliano, 2013). The instructor's communication skills, subject knowledge, and overall role are directly tied to the success of a class excursion (Rodari & Xanthoudaki, 2005). Science center instructors in general:

- Answer visitors' questions,
- Enable them to participate in activities actively,
- Help visitors with how the exhibition setup/experimental device works,
- Accompany the school groups throughout the visit,
- Use exhibits and events not to provide visitors with a textbook-style explanation of a scientific topic but rather to excite their interest in the field,
- Underline that science does not only consist of complicated mathematics and that everything around us has a scientific explanation; they provide a new perspective for perceiving daily events from a scientific point of view.
- Sometimes they repair broken test instruments/exhibition setups (Rodari & Xanthoudaki, 2005).

Teachers and instructors are expected to meet certain standards before, during and after the out-of-school learning activity in a science center. For example, instructors prepare students (visitors) before the trip, support the process with visuals, ensure active participation of students (visitors) during the trip, and collaborate with the teacher. After the trip, they have pedagogical responsibilities such as gathering feedback from students and teachers, evaluating students' individual and group work, and planning assessment and evaluation activities to support teachers (Kanlı et al., 2019). These pedagogical standards are anticipated to be fulfilled by instructors at all science centers and at GUHEM (The Gokmen Space and Aviation Training Center), which was founded as a thematic science center and has only recently begun to receive visitors.

When science centers around the world are examined, it is discovered that a small number of science centers are themed around space and aviation. The National Space Center in England, Cite Espace in France, Space Expo in the Netherlands, the National Air and Space Museum in the United States, and the Euro Space Center in Belgium are among the most popular. With recent developments in space and aviation in Turkey, societal awareness in this area is expected to grow. Therefore, it is critical to supplement young individuals' education in formal learning environments for space and aviation subjects with out-of-school learning environments.

GUHEM (The Gokmen Space and Aviation Training Center) and Its Features

GUHEM (The Gokmen Space and Aviation Training Center) is a 13.500 square meter facility constructed under the leadership of the Bursa Chamber of Commerce and Industry (BTSO) in partnership with the Bursa Municipality and The Scientific and Technological Research Council of Turkey (TUBITAK). GUHEM is the first interactive space-themed center to inspire younger generations to pursue research in high-tech disciplines and enhance Turkiye's international competitiveness through indigenous and national technologies.

GUHEM aims to provide science enthusiasts of all ages with essential knowledge and experience in space, aviation, and technology and inspire younger generations by raising their awareness. With an emphasis on education and experience, GUHEM employs a modern, dynamic learning strategy that supports individual efforts through practices centered on experimentation and creativity. The center features 154 interactive education systems, an aviation training center, a space innovation laboratory, a chemistry, and biology laboratory, mathematics, robotic programming, space, and aviation workshops (Figure 1). In 2019, GUHEM, Europe's largest center and one of only five in the world earned an award in the category of Public Buildings at the European Property Awards (GUHEM, 2022).

Figure 1
Images of Different Parts of GUHEM

GUHEM is regarded as a science center that should be assessed holistically, considering all of its qualifications and experienced instructors. As a result, the purpose of this study was to gather opinions from GUHEM instructors about the GUHEM exhibition contents, the contribution of the exhibition areas to science teaching, and the visitor profiles visiting the center. Simultaneously, within the scope of this study, it was intended to assess the extent to which trainers feel themselves competent in terms of both pedagogical competency and field competence, as well as the points at which they wish to obtain assistance in this process. The study sought answers to the following sub-problems within the framework of this purpose:

1- What are the instructors' opinions about GUHEM?
2- How do instructors perceive their own self-efficacy in science teaching?
3- How do instructors perceive their own educational competence?

When the studies in the related literature were examined, it was discovered that, while there are many studies based on science centers (Bozdoğan, 2017; Çığrık, 2016; Çolakoğlu, 2017; Koyuncu & Kırgız, 2018), there are few studies on taking the opinions of science center instructors and evaluating the exhibition contents in this context. To that end, this study will contribute to the literature by obtaining detailed information about the performance of other science centers designed as thematic science centers in this manner, particularly GUHEM, as well as the instructor requirements. It will also show how advances in space and aviation are handled in thematic science centers, one of the most popular out-of-school learning environments.

Research Methodology

Research Design

One of the qualitative research methodologies used in this study was the case study approach which makes it easier to explain a phenomenon in its context. This prevents focusing on the problem from a single perspective and offers a viewpoint that enables the phenomenon to be revealed and comprehended in various ways (Baxter & Jack, 2008). The study's focus was on the GUHEM instructors, as well as their opinions on the exhibition's themes, how the exhibition areas contribute to science education, the visitor types who visit the center, the degree to which they view their own pedagogical and professional expertise as sufficient, and the areas in which they would like support during this process. For these reasons, the case study approach was chosen as the most effective methodology.

Participants

Nine instructors that work for GUHEM took part in the study. Although the total number of instructors working in GUHEM was 14, only 9 of these instructors worked full-time. The remaining five instructors continued their duties on a part-time basis. Full-time instructors were included in the study because they spent more time with visitors and observed the environment for longer. In addition, seven of the instructors have previously visited another science center in Turkiye. Table 1 shows the instructors' demographic characteristics.

Table 1
Demographic Characteristics of Instructors

Gender	*f*
Female	5
Male	4
Age	
20-25 years	3
26-31 years	3
31-36 years	3
Profession	
Science Education	1
Biology Education	1
Physics Education	1
Aeronautical Engineering	1
Astronomy and Space Sciences/Science Communications	5

Procedures

The study's data-gathering tool comprised nine open-ended questions on an opinion form (GUHEM Instructors Opinion Form). The researcher created this form to ascertain the instructors' opinions about the age groups that frequently visit GUHEM, a science center themed around space and aviation, the available exhibition areas, and how these exhibition areas contribute to the teaching of science. In addition, it was prepared by the researcher to determine their views on the situations that forced them or caused the disruption of work during the visits to GUHEM and the situations in which they felt inadequate in guiding the visitors or they needed professional support. Two science educators who have experience visiting popular science centers in Turkiye (Konya Science Center, Bursa Science and Technology Museum), as well as science centers in cities like Lisbon (Pavilho do Conhecimento) and Copenhagen (Experimentarium) were asked for their professional opinions on the opinion form. As a result, the form's content validity was guaranteed. The instructors received the opinion form via email and had about a month to reply. It was created as an online form. The content of the opinion form is given in Appendix 1.

Data Analysis

Content analysis was used to analyze the data obtained through the opinion form. By grouping the obtained data under a particular topic or theme, the content analysis aims to conceptualize and interpret the data that are comparable to and connected to one another. In this method, data that have been logically arranged are presented in a way that the reader can comprehend (Yıldırım & Şimşek, 2011). Additionally, examples of expressions discovered using content analysis are included in the tables below, and the abbreviation 'I' was used for the instructor in the research. For example, I5 represents the fifth instructor.

Validity, Reliability, and Ethics

A qualitative researcher's strategies for ensuring consistency or reliability include triangulation, expert review, researcher position, and verification procedure (Richards, 2005). An expert opinion was obtained for the data collection tool prior to the study to ensure internal validity and credibility, and participants' voluntary participation was guaranteed. Multiple data sources were used for data triangulation. Two researchers recoded the study's data to verify coding reliability. According to Miles and Huberman (1994), there should be at least 80% consistency amongst coders for coding reliability and the internal consistency of the study. Following the simultaneous coding, the reliability of the coders was evaluated. Each researcher independently coded the data. Due to various discrepancies at the initial check, two researchers jointly examined the data, settled any code differences, and adjusted codes as necessary. They eventually reached an understanding of their coding. The intercoder agreement was 98% after the second check, and the coding procedure was reliable. The University Human Research Ethics Committee permitted the researchers to access instructors. The participants were assured that they had the freedom to leave the study at any moment, and their names were kept private.

Research Results

Within the scope of the study, the first question asked to the instructors was, "What age range do you think the groups that visit GUHEM are in general?" appears in the form. When the responses to this question were evaluated, six instructors stated that the majority of visitors to the science center were between the ages of 6 and 11. In comparison, three instructors noted that most of the visitors were between the ages 11 and 15.

The instructors were then asked, "What do you believe is the cause or reason that visitors visit GUHEM?". Table 2 shows the themes, codes, and frequency values that were generated based on the responses to this question:

Table 2
Reasons to Visit GUHEM

Theme	Codes	Instructors	*f*
Be a topic of interest	Space and aviation	I1, I3, I4, I5, I6, I9	6
The structure of the center	Learn by doing/trying	I2	1
Feature of the theme	Have media coverage	I8	1
	Being a work-in-progress	I7	1

According to Table 2, most instructors see children's interest in space and aviation themes as the primary motivation for visiting GUHEM. Apart from that, the trainers state that the center's structure allows visitors to learn by experimenting and doing, that developments in space and aviation are frequently shared through the media and that the progress we have made as a country in this field are also reasons for visiting GUHEM.

The third question in the opinion form is, "What do you think is the most fundamental trait or feature that distinguishes GUHEM from other thematic science institutions in Turkey and other countries?". Table 3 shows the themes, codes, and frequency values generated based on the responses to this question:

Table 3
Features that Make GUHEM Different from Other Science Centers

Theme	Codes	Instructors	*f*
Being a thematic science center	Themes in aviation and space	I2, I4, I6	3
	Be different in content	I1, I2, I5, I6, I8	5
	Being the largest center in Europe	I8, I9	2
	Associated with other disciplines	I7	1
The design is unique	A large number of interactive devices	I1, I3	2
Features of the instructors	Expertise in their field	I1	1

According to Table 3, most instructors noted that the fundamental feature distinguishing GUHEM from other thematic science centers is that the display sections in its content are related to space and aviation and are given to visitors in a certain flow. Besides that, GUHEM's technological features, high-level products, and interactive mechanisms draw attention not only to space and aviation themes but also to other disciplines. The fact that each of its instructors is an expert in their field is cited as a distinguishing characteristic. The following are some of the instructors' responses to the prominent codes:

> *"Thematically arranged mechanisms can be experienced in a specific flow and story dimension. (I6)", "The fact that there are many interactive mechanisms and that it is a newly opened, up-to-date science center. (I3)", "Employees are subject matter experts, there are several interaction mechanisms. There are simulators and laboratory facilities located beyond the exhibition area. (I1)".*

The fourth question in the opinion form is, "Which discipline or disciplines do you believe the GUHEM exhibition areas contribute to learning?". Table 4 shows the themes, codes, and frequency values that emerged from the instructors' responses to this question, which are then reinforced by sample quotations.

Table 4
GUHEM and Related Disciplines

Theme	Codes	Instructors	*f*
Related disciplines	Astronomy	I1, I3, I4, I5, I6, I7, I9	7
	Aviation	I1, I3, I4, I5, I6, I7, I9	7
	Physics	I1, I3, I7, I8	4
	Biology	I3, I7, I8	3
	Chemistry	I1, I8	2
	Technology	I1, I3	2
	Astrobiology	I7	1
	Math	I7	1
	History	I8	1

According to Table 4, most instructors claimed that the mechanisms in GUHEM contribute to the teaching of astronomy and aviation subjects in general. In addition to these subjects, instructors have noted that GUHEM supports teaching science disciplines such as physics, biology, and chemistry. On the other hand, the instructors believe that astrobiology, a current topic area that has just recently begun to be studied alongside technology, history, and mathematics disciplines, can be assisted by the mechanisms in GUHEM and the activities carried out there. The following are some of the instructors' responses to the prominent codes:

> *"It contributes to basic sciences within the theme of astronomy and aviation. (I6)", "I think it contributes to the teaching of disciplines such as science, history, and mathematics. (I2)", "In addition to having a direct impact on very basic and comprehensive sciences like physics, biology, astronomy, engineering, aviation, mathematics, and chemistry, I believe it also contributes to the learning of astrobiology. (I7)".*

The fifth question in the opinion form is, "Which of the GUHEM exhibition areas do you believe attract the most attention? Why?". The themes, codes, and frequency values derived based on the instructors' responses to this question are displayed in Table 5 below and supported by sample quotations.

Table 5
Interesting Exhibition Areas in GUHEM

Theme	Codes	Instructors	*f*
Space and astronomy	Planets	I1, I2, I3	3
	Doppler effect	I1, I3	2
	Robot arm	I1, I3	2
	Space technologies	I3	1
	Thermal camera	I1	1
Aviation	Simulators	I6	1
	A-320 Airbus	I7	1
	Delta wing	I1	1

According to Table 5, the majority of the instructors stated that the interesting exhibition areas in GUHEM are those related to space and astronomy. The instructors also noted that the simulators exhibited under the aviation theme, the exhibition space developed with a cross-section taken from a real A-320 Airbus, and the delta wing construction drew visitors' attention. I4, I5, I8, and I9 coded instructors, on the other hand, did not expressly mention an exhibition area, though they did state that space and astronomy were popular. The following are some examples of instructor responses:

> *"Space and astronomy because space has always piqued humanity's interest, and most people have dreamed about going to space. Humans are more interested in planets, stars, and galaxies. (I2)", "The exhibition area, built from parts of a real airliner named the A-320 Airbus, draws the greatest attention. I think the reason is that passenger jets, which are difficult to study in detail despite being utilized for travel in real life, can be presented in depth and immediately observed and tested. (I7)".*

The sixth question in the opinion form is, "Can you give an example of an interactive workshop activity with GUHEM visitors?". Table 6 shows the themes, codes, and frequency values that arose from the instructor's responses to this question, which are then reinforced by sample quotations.

Table 6
Interactive Workshops Held at GUHEM

Theme	Codes	Instructors	*f*
Workshops related to aviation	Paper (Model) airplane activity	I4, I5, I6, I8	4
	Flight adventure	I2, I3, I8	3
Workshops related to astronomy	Rocket competition	I1, I3, I5, I9	4
	Life on the Moon	I1, I7	2
	Soilless agriculture	I1, I3	2
	Amateur meteorite fishing	I3	1

According to Table 6, the instructors' perspectives on the interactive workshops offered at GUHEM were organized into two themes: aviation and astronomy. The flight adventure workshops, which were presented in the form of creating paper airplanes and having participants experience flying in the presence of simulators, stood out among the workshops stated under the aviation theme. On the other hand, the astronomy workshops include rocket competitions, life on the moon, soilless agriculture, and amateur meteorite searching. Some of the instructors' responses are as follows:

> *"A flight adventure: Following the aviation presentation, participants fly with Cessna simulators." Following that, a model airplane workshop is held. (I7)", "Rocket competition: Participants create their own rockets and then launch them from the launch pad to compare the results. (I9)", "Agriculture and plant orientation motions in space: Hydroponic farming is used in a chemistry-biology laboratory. (I3)".*

The seventh question in the opinion form is, "Can you offer us any instances of science concepts that visitors to GUHEM learn in a short period?". Table 7 shows the themes, codes, and frequency values that stand out concerning the instructors' responses to this question, which are then reinforced by sample quotations.

Table 7
Science Concepts that Can be Learned in GUHEM

Theme	Codes	Instructors	*f*
Astronomy	Solar system and planets	I1, I2, I3, I6	4
	Gravity	I3, I8	2
	Eclipses of the Moon and Sun	I9	1
Physics	Pressure	I4, I5, I7, I8	4
	Simple machines	I1, I5	2
	Air friction and buoyancy	I7, I8	2
	Bernoulli's principle	I1, I5	2
Material science	Properties of materials	I1	1

According to Table 7, instructors stated that the exhibition areas in GUHEM contributed to teaching many science concepts. These concepts are gathered under the disciplines of astronomy, physics and materials science. The instructors frequently addressed the themes "Solar System and Planets" and "Pressure". In addition to these concepts, it was discovered that the instructors expressed some definitions such as gravity, basic machines, air friction and buoyancy, Bernoulli's principle, lunar and solar eclipses, and material qualities. Some of the instructor's responses are as follows:

> *"... Solar system, stars, planets, meteorites, Mars and Moon studies. (I1)", "Use of pressure difference in aviation. (I4)", "Gravity, artificial satellites, buoyancy, pressure, and friction are a few examples. (I8)", "Simple machines, Newton's law, pressure, Bernoulli's principle. (I5)".*

The eighth question in the opinion form is, "Are there any situations that force or disrupt their visits to GUHEM?". Table 8 shows the theme, codes, and frequency values derived from the instructors' responses to this question, which are then supported by sample quotations.

Table 8
Instructors' Problems Encountered during Visits

Theme	Codes	Instructors	*f*
Problems caused by visitors	The anxiety of not fulfilling expectations	I2, I3	2
Not encounter any difficulties		I1, I4, I5, I6, I7, I8, I9	7

According to Table 8, the majority of the instructors indicated that they did not experience any issues or that the work did not go wrong during their visits to GUHEM. However, I2 and I3 coded trainers reported difficulty due to worries such as feeling insufficient in fulfilling the visitors' expectations, not being impressive in front of them, and decreased engagement with students, particularly in school groups. Instructor responses to this code are as follows:

> "*It can be challenging to simultaneously please each guest in the same way. We can meet people of varied styles and see how some people approach things differently. This can occasionally cause difficulties. (I2)", "Reducing interaction with students in school groups through intensive visits and attempting to convey information by competing with time. The fear of "influencing" the participant takes precedence over the motivation to provide information and the participant's curiosity. (I3)".*

The last question in the opinion form is, "As an instructor, are there times when you feel incompetent in leading visitors to GUHEM or when you want professional assistance?". Table 9 shows the themes, codes, and frequency values defined based on the instructors' responses to this question, which are then supported by sample quotations.

Table 9
Situations in Which Instructors Feel Insufficient

Theme	Codes	Instructors	*f*
Feeling insufficient	Failure to master the subject	I3, I4, I5	3
Inability to exert dominance over visitors		I2	1
	Inability to respond to various questions	I8	1
Not feeling insufficient		I1, I6, I7, I9	4

According to Table 9, during several of the visits to GUHEM, some of the instructors felt inadequate. One of these circumstances is a lack of precise knowledge of specific subject areas. Furthermore, the instructors identified weaknesses in themselves, such as having difficulties establishing dominance over packed visitor groups and not being able to respond adequately to unexpected questions from visitors. The following are some examples of inadequate situations:

> *"I occasionally feel insufficient to dominate large group visits. (I2)", "Aeronautics and biochemistry are areas where I fall short as an astronomer. I think I have little understanding in this sector and, more significantly, that I am ineffective at communicating my current knowledge to people of all ages. (I3)", "When asked really specific questions, I sometimes feel inadequate. (I8)".*

Furthermore, instructors with codes I1, I6, I7, and I9 reported that they never felt inadequate during the visits at GUHEM.

When GUHEM instructors were asked about their previous visits to science centers, it was determined that most of the instructors visited popular science centers in Turkey such as Bursa Science and Technology Center, Konya Science Center and Feza Gürsey Science Center.

Table 10
Experience of Science Center Visiting

Theme	Codes	Instructors	*f*
Visiting another science center	Feza Gürsey Science Center	I3, I4, I5	3
	Konya Science Center	I6, I9	2
	Bursa Science and Technology Center	I1, I8	2
Not visiting another science center		I2, I7	2

Discussion

Astronomy is a science that incorporates and is centered on physics, chemistry, geology, mathematics, and other sciences. The advancement of astronomy and the improvement of other sciences show parallelism. Astronomy can be used to teach students subjects such as physics, mathematics, and chemistry. For example, in chemistry class, he can explain how elements are formed using the subject of stellar evolution; in physics class, he can easily use astronomy to explain the Doppler effect and the expansion of the universe. Just as anatomy is required to understand the human body, astronomy is necessary to understand the universe (Koçak, 2022). These relationships between astronomy, aviation, and other disciplines require individuals to learn astronomy concepts accurately and concretely from an early age. Concepts in astronomy are frequently abstract, making learning and comprehending basic astronomy concepts difficult (Yu, 2005). Many studies have shown that both adults (Mant & Summers, 1993; Sharp, 1996; Trundle et al. 2002;) and students (Kalkan & Kıroğlu, 2007; Trumper, 2000) have many misconceptions and incorrect mental models of fundamental astronomy concepts. To address this issue, developed countries have prioritized astronomy training and education, establishing planetariums, observatories, and science centers in nearly every city across the country. In light of all of these studies, this study, which was conducted to obtain the opinions of the instructors working at GUHEM, was able to reveal what kind of contributions can be made to the teaching of other science subjects, particularly astronomy and aviation, as well as what the instructors' needs are in carrying out activities at GUHEM and similar thematic science centers.

Plummer (2009) used kinesthetic learning techniques to investigate how students' understanding of apparent celestial motion changed after participating in a planetarium program. Participants ($N = 63$) from the first and second-grade students were interviewed before and after the study. It was determined that students' knowledge of all visible celestial motion fields covered by the planetarium program improved significantly. This result demonstrated that students in the early stages of primary school could learn the correct definition of apparent celestial motion. The findings also show the importance of kinesthetic learning techniques and the planetarium's rich visual environment to understand celestial motion better. Türk and Kalkan (2015) sought to ascertain students' knowledge of specific astronomy concepts as well as the impact of a planetarium environment on teaching. Students in the seventh grade (12-13 years old) are included in the study. The study included 240 students of various socioeconomic and cultural levels from six schools. The study used the experimental method, and the "Solar System and Beyond" unit was preferred. The current study's findings revealed that teaching astronomical concepts in a planetarium environment is more effective than in a classroom setting. The study also found that students in the planetarium-supported group performed better than the control group in subjects that required 3-dimensional thinking, changing time, and observing periodic motion. Similarly, according to the findings of this study, visitors have detailed knowledge of the solar system and planets thanks to the exhibitions at GUHEM and the guides' explanations. (Table 7). Doğru et al. (2019) analyzed studies on astronomy education. As a result of the study in which theses and articles were examined, it was revealed that astronomy education was mostly carried out in out-of-school learning environments and planetariums. On the other hand, these studies were mainly carried out with secondary school students focused on the realization of conceptual teaching. In this context, in this study, GUHEM has been shown by the instructors as an out-of-school learning environment for teaching astronomy and aviation concepts in detail.

In contrast to GUHEM, numerous studies on science centers operating in Turkey have been conducted. By discussing research that assesses science centers and their effects from many angles, Gürsoy (2022) highlighted the significance of science centers in science education. According to Yalkın Şentuna (2019) research findings, 90 experimental sets in the Kocaeli Science Center Dynamic World Gallery resulted in the acquisition of 57 Our World and the Universe learning area successes. Kocaeli Science Center Dynamic World Gallery must have been created based on the outcomes of the science course curriculum. The majority of studies were conducted with an emphasis on science center exhibition areas and how they helped with science teaching. Still, few studies examined the opinions of science center instructors. In this study, the instructors at GUHEM, a thematically designed science center, were asked about the exhibition areas and how they support science teaching, as well as about the visitor demographics and their own educational backgrounds. For this reason, several viewpoints were considered while comparing the data collected and the findings of related studies in the literature.

According to instructors, primary school pupils between the ages of 6 and 11 make up the majority of GUHEM's visitors. In light of this finding, the interactive activities in this space and aviation-themed center will help young visitors include goals like becoming scientists in their career plans and engage in space studies, as well as get closer to the breakthroughs that Turkiye intends to achieve within the framework of the "National Space Program". Some basic concepts of astronomy, such as natural cycles, are taught in grade one (age 6), but the primary "dose" of astronomy occurs in grade six (age 11), when astronomy and space account for one-fifth of the science curriculum - at least in theory (Percy, 2009). The contents of the exhibition areas at GUHEM have been considered to be closely related to the primary and secondary science curriculum. In reality, GUHEM mechanisms can aid in teaching a wide range of courses and concepts, from the third-grade science curriculum to the eighth-grade. These subjects begin in third grade with "Let's Get to Know Our Planet," fourth grade with "The Earth's Crust and the Movements of Our Earth," fifth grade with "Sun, Earth, and Moon," sixth grade with "Solar System and Eclipses," seventh grade with "Solar System and Beyond," and eighth grade with "Seasons and Climate" (MoNE, 2018). Similarly, it is believed that GUHEM mechanisms can be highly effective in teaching concepts such as energy conservation, friction and kinetic energy loss, and air and water resistance, which are covered in the "Energy Transformations" subject taught in the 7th-grade science course curriculum. Babaoğlu (2016) revealed how they describe astronomy concepts in students' minds, and their cognitive representations before and after the activities carried out within the scope of the 6th-grade unit in a secondary school in the Çumra district of Konya. As a result of the focus group meeting, it aimed to get their opinions on the experience and contribution to the concepts of astronomy. The study revealed that students' views of astronomy ideas varied in a good way when the drawings they drew before and after the activity were compared. From this vantage point, it is expected that GUHEM, which is themed on space and aviation, will increase students' awareness of astronomy.

Each student group is accompanied by an exhibition guide and an education guide, and the visits run for about two hours. The touch-and-discover technique is mostly used, with students visiting exhibition areas and attending workshops. Visitors have the opportunity to learn firsthand by participating in scientific events in exhibition areas and instructional sessions in GUHEM. Visitors also have the chance to see astronomical occurrences in this atmosphere quickly, but it typically takes days or years to happen. Given all these benefits, it is believed that GUHEM will continue operating as a thematic science center with significant educational value. The key characteristic that sets GUHEM apart from other science centers, according to the instructors' responses, is that it has a different content. Erçetin and Görgülü (2018) investigated the perspectives of sixth-grade visitors to Konya Science Centers regarding the Science course. Twenty students were chosen from a state school in Konya for this study, and they took part in a field trip to the Konya Science Center while being informed of the study's goals. If we were to outline the issues and findings of the study, it was discovered that most of the students went on the field trip to the science center to learn new things. Özcan et al. (2019) aimed to get secondary school students' opinions after their Konya Science Center trip. According to sixth-grade students, one of the stated motivations for visiting the science center was to learn more in-depth information about the solar system and space. In this context, it may be claimed that students have similar reasons for visiting GUHEM.

Similarly, astronomy and aviation were answered in the first place to the question of what disciplines are related to the exhibition areas in GUHEM. The instructors also mentioned the subdisciplines of science, mathematics, history, and astrobiology in addition to their responses. Even though GUHEM is a specialized science center, it features exhibition spaces for subjects like other sciences that are relevant to education. Paper (model) airplane construction for aviation and rocket competition for astronomy are the two activities that take center stage at the start of the interactive workshops in GUHEM. Both activities draw interest from children between the ages of 6 and 11. It is believed that encouraging children to visit science centers with engaging activities will surely have a good impact on their attitudes toward science. Balçın and Şeker (2019) aimed to get the opinions of 14 secondary school students about travel and astronomy after they visited Kocaeli Science Center. The students claimed that the science center had benefited them in several ways, including providing information, fostering an atmosphere of entertainment, exploration, and experimentation, encouraging the development of their imaginations, and contributing to science. They also claimed that the knowledge they had gained about the cosmos would be useful to them in school, in the future, and their careers.

The idea of not meeting visitors' expectations and being unable to understand the subject was stated when the instructors' opinions on the problems were analyzed. Kim and Song's (2003) study looked into the characteristics of the exhibitions in three Seoul science museums and centers and gathered student feedback on the displays. The research's findings showed that while most students claimed that interactive exhibits captured their interest and that the exhibition's explanation panels had helped them comprehend its workings, 20% claimed that they had never read the panels. Additionally, students claimed that the guides' verbal explanations were more understandable than the written ones on the panels. In this situation, it will be more beneficial for the guides to look after the tourists and direct them in accordance with their areas of specialization. It will also help the guides develop their sense of self-efficacy.

Conclusions and Implications

This case study is crucial to understanding GUHEM, a thematic science center, and identifying the educational challenges the trainers face. Individuals visit GUHEM mainly due to the thematic area's interest in space and astronomy.

The Solar System material in GUHEM, which depicts the planets scaled according to the size variable, comparatively, as can be observed from the instructors' answers, is one of the most remarkable astronomy-related processes. It is worth observing the feelings of surprise and curiosity that children and young people experience as they examine and compare the planets when they come across the scaled three-dimensional macro solar system model, even though they have learned the information from textbooks and while teaching astronomy-related science topics. Visitors are more receptive to learning, asking questions, and gaining in-depth knowledge when they see all the solar system's components at scale and have the chance to move around, touch them, and view them from all angles. At this point, GUHEM's most significant role as a center for thematic science learning begins to emerge. On the other hand, GUHEM distinguished itself from other science centers by encouraging visitors to grow their interest in science through interactive programs.

According to the study's findings, each GUHEM instructor who participated in disseminating knowledge about the mechanics connected to the space and aviation topic overlapped with the exhibition areas. Despite this, it is an interesting finding that instructors worry about not being able to master the material and not being able to live up to visitors' expectations. It also serves as a reminder to teachers that content knowledge is not enough for educational activities; additionally, pedagogical competencies are needed. It is believed that external support should be provided as a result.

Science centers are mainly ineffective for students who are ill-equipped, uninterested, or unmotivated. For this reason, it is believed that visits done with prior knowledge will positively impact the students' learning. Teachers are expected to coordinate with the instructors as they describe the things seen and their scientific significance, and to contrast the knowledge from their areas of expertise-such as astronomy and the history of science-with that found in the textbooks. When a student observes that his teacher and the instructor are not in harmony and cooperation in any subject, his willingness to study is undermined, and his "learning confidence" regarding any new information deteriorates. Primary and high school teachers that teach astronomy have a limited understanding of the subject. As a result, the teacher and the guide must have complimentary communication. Teachers can utilize astronomy to discuss topics linked to basic sciences since astronomy and aviation are multidisciplinary fields of study. Teachers and astronomers can get together before they talk and conduct cooperative research on the topics. It is advised to obtain the necessary assistance from academicians working in this field to resolve the educational challenges and issues educators face and to present mixed communities of teachers and trainers seminars tailored to their requirements.

Astronomy education is critical for directing young people studying in a country toward science and technology and stimulating their curiosity and imagination. The most developed countries are still working to establish space-based life centers. Serious research into space mining has begun. After the moon, humanity may set foot on Mars in the next 20 years. We, as Turkey, should provide more accurate astronomy and space education and train qualified personnel in the field of space technology. It is recommended that these and similar studies contribute to training the instructors working in GUHEM, designed around the space and aviation theme, as qualified personnel.

Declaration of Interest

The author declares no competing interest.

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Appendix 1.

Dear Instructors,

This form collects information about the exhibition areas at GUHEM, such as which disciplines these exhibition areas contribute to learning, your views on visitor profiles, and so on. The information gathered will be invaluable in revealing GUHEM's potential and your requirements as an instructor.
Thank you in advance for your answers and best wishes.

Assist. Prof. Dr. Ayşegül ASLAN
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1- What age range do you believe the majority of visitors to GUHEM are?	○ *3-6 ages* ○ *6-11 ages* ○ *11-15 ages* ○ *15-18 ages* ○ *18-23 ages* ○ *23-35 ages* ○ *35 years and older*

2- What do you believe are the main reasons why people visit GUHEM?

3- What do you believe is the most fundamental feature or features that distinguishes GUHEM from other thematic science centers in Turkey and other countries?

4- Which discipline or disciplines do you think contribute to the learning of the exhibition areas in GUHEM?

5- Which of the exhibition areas in GUHEM do you think attracts the most attention? Why?

6- Can you give an example of workshop activities held interactively with visitors to GUHEM?

7- Can you give examples of the science concepts that the visitors of GUHEM learned in a short time?

8- Are there any situations that force you during the visits in GUHEM and cause disruptions in business? If your answer is yes, can you explain?

9- Are there any situations where you feel inadequate in guiding visitors as an instructor, or do you need professional support? If your answer is yes, can you explain?

10- Have you visited a science center in Turkey or in a different country before? If your answer is yes, can you explain?

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PROBLEMS
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POSSIBLE FACTORS DETERMINING SATISFACTION OF DISTANCE EDUCATION AMONG UNIVERSITY STUDENTS

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Abstract

The aim of the study was to find out the factors, which significantly affected satisfaction with distance education among university students (undergraduate students). Complete data were obtained from 1283 respondents from different faculties in Czech Republic during the second term in academic year 2021/2022. The items in research tool were Likert type and also semantic differential was used. The descriptive, inferential and multidimensional statistic were used for data evaluation. Independent variables like: Evaluation factor for full-time form; Activity factor for full-time form; Difficulty factor for combined form; Evaluation factor for combined form; Activity factor for combined form; Perception of distance learning through negatives and Perception of distance learning through positives were as significant, which influenced satisfaction with distance education. Implications for pedagogical practice are presented in the conclusion part.

Keywords: *multiple regression model, quantitative approach, satisfaction of distance education, university students*

Introduction

Distance education is in the easy way a type of education, where the learner is not physically presented at the lesson. The last years (2020 and 2021) bring a huge number of opportunities, how to correctly and effectively use different tools, which distance education offers. However, it is important to reflect that pandemic situation revealed lack of experiences with educational technology and work with it (Bergdahl & Nouri, 2021). This situation created a big pressure on both sides of education process, what led to different approaches of teaching process. And these various situations could cause severe distinct perceptions toward distance education. The using of distance learning brought many advantages and disadvantages. Respondents evaluated positively for example the time flexibility, and low financial burden. As disadvantages were mentioned for example social isolation, procrastination, and missing lecturers (Lamanauskas & Makarskaitė-Petkevičiené, 2021; Srivastava, 2019; Yasynska, 2020, Zhao et al., 2020).

Except for the concept “distance education”, other terms occur, the main difference among them is shown below. Distance education is based on a didactically high-quality design of materials, which must replace the interactivity between the student and the teacher that is common in face-to-face teaching, and it is based primarily on self-study (Ng, 2019). In contrast, online education (e-learning) is teaching to use computer technology, electronic devices, and the Internet. Online learning regularly involves face-to-face interaction between teachers and students. The characteristics of emergency remote teaching are a sudden, uncertain start, constant variability due to the epidemiological situation, lack of time to prepare everything flawlessly in advance, or the diverse home background of the students, which the school can only influence to a limited extent (Tulaskar & Turunen, 2022).

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Current State of Literature

Some researchers focused on the satisfaction with distance education on their institution. For example, Datt and Singh (2021) found out that students were satisfied with e-services, such as online admissions, online examination forms, access to view and download evaluation results. Jegathesan et al. (2018) and Rajabalee and Santally (2021) found out positive correlation between distance education satisfaction and performance. The perception of the distance form of education in the sense of e-learning, therefore, passes through the perception of ICT technologies in education. From the perspective of e-learning, which is necessary for distance learning, students' perceptions of ICT technologies appear to be a key factor (Rafiq et al., 2020). Students' attitudes and perceptions of these technologies have already been mentioned in research, but most studies have focused only on technologies and their acceptance by students (Sharma et al., 2020). To some extent, the question of students' perceptions of distance form of education (e-learning) remains neglected. As the research described by Johnson et al. (2021) shows, most students have reasonably strong ICT skills and a positive attitude towards e-learning. In developed countries, university students have different attitudes towards e-learning, however, most of them report a positive perspective. In contrast, the lack of choice of form of education and the need to be constantly in the information space has caused an increase in tension and resistance among teachers as well as students (Thatcher et al., 2020). The results have shown that students in general prefer face-to-face education over distance learning. On the other hand, working students (part-time or full-time) reported a positive approach to distance education (Benhima, 2021).

The perception of the distance form of teaching and technologies in education is generally closely related to the issue of socio-economic status. Some students with low socio-economic situations have got more problematic access toward modern technologies, distance education is for them more demanding (Yang et al., 2018; Chillemi et al., 2020). From the point of view of Roger's theory of diffusion of innovations, it holds that the socio-economic status influences the probability of acceptance of a given innovation. The level of the family SES has a positive correlation with the pupil's own success. Some authors add that pupils with a high level of SES perform better than pupils from the middle class, who, however, perform better than pupils from families with low SES. This aspect can be measured both objectively (using appropriate tools) and subjectively (self-assessment of one's position) where the result is a kind of subjective classification of the individual into a particular social group or class. The strong influence of SES (especially the education of parents) on the school success of the pupil has already been addressed by many experts (for example Farooq et al., 2011). Their research, as well as a number of other probes, show that the socio-economic status in terms of parental education causes pupils of more educated or better-off parents perform better at school than other pupils. It is an important variable because the development of human capital is linked not only to the well-being of an individual, but also results in increased productivity, leading to new sources of income which means increasing economic growth of a country. Similar results were possible to find out in the study by the Chytry et al. (2022).

On the basis of theoretical framework, the aim of the study was to find out, which factors influenced the satisfaction with distance education among university students.

Research Methodology

General Background

The study has got a quantitative approach toward obtaining and analyzing data. The study is an exploratory, correlational type, aimed to research selection of factors influencing satisfaction with distance education among university students. All variables were measured with valid and reliable scales. Data were collected in the middle of the second term in academic year 2021/2022 and the data collection took two months.

Sample Selection

The calculation of the size of the file was calculated based on the Sample Size Calculator with Confidence Level 95 % and Margin of Error 5 % (Population Proportion 50 %) with a base file of *N* = 304000. The detected sample size is *N* = 385. This means 385 or more measurements/surveys are needed to have a confidence level of 95 % that the real value is within ±5 % of the measured/surveyed value. Complete data were obtained from 1283 respondents (men = 259, 20 %, women 1024, 80 %). These respondents attended both full-time (*N* = 826, 64 %) and combined (*N* = 457, 36 %) forms of study. Respondents also attended various secondary schools: grammar school (*N* = 500, 39 %), secondary pedagogical school (*N* = 141, 11 %), secondary art school (*N* = 57, 4 %), secondary vocational training school (*N* = 12, 1 %), secondary medical school (*N* = 73, 6 %), secondary technical school (*N* = 90, 7 %), secondary business school (N = 14, 11 %), and secondary vocational school (*N* = 269, 21 %).

The composition of the respondents is also diverse in terms of the studied faculty. As the field of expertise is education, the maximum focus was placed on the students of faculties of education (*N* = 452) or faculties of socioeconomics (*N* = 225). Respondents were selected from various universities and faculties in order to map various places in the Czech Republic.

Instrument and Procedures

A total of six research tools were used in data collection. These instruments are built on Likert scales and are not evaluated individually, but as a whole (or on the basis of partial subtests (table 1 in more detail). Due to the continuation of the Covid-19 pandemic, the individual tools were distributed to the respondents in electronic form. The table 1 shows how many items these tools have, what their focus is, and what the psychometric features are. The detailed description of used scales is presented in the following subchapter.

Data Analysis

Due to the nature of the data, first the Cronbach α coefficient was calculated which determines the internal consistency of the tool and can take values in the range ⟨0.1⟩ with generally acceptable values of the coefficient being between .70 and .95 (Tavakol & Dennick, 2011). This interval can be specified as follows: minimally acceptable (>.70), good (> .80) or excellent (> .90) (George & Mallery, 2003). In this context, the work of van Griethuijsen et al. should be mentioned (2015), who declare that the values between .60 and .70 are acceptable (this question is discussed in detail mainly due to the use of the tool focusing on the relationship to the full-time form of study).

The last limit, which is the strictest for estimating reliability, is also mentioned by Hopkins (1998), who states that while standardizing a research tool only reliability higher than .90 can be considered sufficient. In the presented paper, the analysis of psychometric features was supplemented by the values of split-half reliability due to a slightly lower value of one of the variables (Relation to the full-time form of study). Split-half reliability was always calculated with reduction based on Spearman – Brown correction (Table 1).

Table 1
Description of Tool Evaluation + Measured Reliability

Tool focus	Number of items	Features	Evaluation
Satisfaction with distance form of learning (SwDFE)	8	α_{cr} = .83, split half = .84	Sum of individual items. Values range from 8 to 40. The higher the value, the worse the relationship to the distance form of education.
Perceives distance learning through positives	12	α_{cr} = .80, split half = .87	Sum of individual items. Values range from 12 to 60. The higher the value the better the relationship to the distance form of education.
Perceives distance learning through negatives	8	α_{cr} = .84, split half = .86	Sum of individual items. Values range from 8 to 40. The higher the value, the worse the relationship to the distance form of education.
Relationship to full-time form of study	9	α_{cr} = .68, split half = .77	Items divided according to factors into: e – evaluation factor (3 items) - values 3 – 21 d – difficulty factor (3 items) - values 3 – 21 a – activity factor (3 items) - value 3 – 21 The sum of individual items is worked with
Relationship to combined form of study	9	α_{cr} = .73, split half = .85	Items divided according to factors into: e – evaluation factor (3 items) - values 3 – 21 d – difficulty factor (3 items) - values 3 – 21 a – activity factor (3 items) - value 3 – 21 The sum of individual items is worked with.
Socio-economic status	7	Not measured	Evaluated through octiles on a scale 1-7. The lower the value, the higher the SES.

Based on the values from table 1 it is clear that it is possible to continue working with these individual tools. These tools are usually based on the Likert scale, or a semantic differential is used. The only exception occurs in the case of socio-economic status (more details below). In the case of tools built on the Likert scale (*) both a seven-point scale (*a) and a 5- point scale (*b) are used and from the perspective of psychometric features there is no difference between them. When the evaluation of the entire Likert scale (in this case of a specific tool) is discussed then one variable is meant which was created by merging (in this case the sum of) items into one variable (Boone & Boone, 2012). In this case, it will be based on the conclusions and the use of the scale by a number of authors (for example, Baggaley & Hull, 1983; Maurer & Pierce, 1998) and considered by the given variable an interval. According to Boone and Boone (2012), it is necessary to use parametric statistical methods to process data on an interval scale. At this point, it should be mentioned that due to the size of the set ($n \geq 20$), the approximation using the central limit theorem, which simply says that the sum of a large number of random variables behaves as a normal distribution, can be used. For this reason, the use of parametrical statistical methods will continue.

The satisfaction with distance learning was considered a dependent variable and all the others are considered independent variables. The detection of outlying values was performed by the method of internal walls. Based on the minimum and maximum compared to the values of the outer walls, it is possible to say that none of the variables will be removed from the data matrix because none of them becomes extremely remote. Testing of data normality was performed on the basis of the Shapiro-Wilk test for normality at the 5% level of significance (the conclusions confirm the possibility of using parametric statistical methods, as indicated above).

The last method used was to map the socio-economic status, where the socio-economic score of the household and then the ABCDE classification was used. Both were developed and designed by MEDIARESEARCH, JSC. The ABCDE classification is defined as a categorization of the socio-economic score of households. It contains 8 categories A, B, C1, C2, C3, D1, D2, and E, which are defined as octile of the socio-economic score in the population of all households in the Czech Republic. The following table contains the limits for the socio-economic scores defining the individual ABCDE categories (limits valid for the calendar year 2021 – table 2).

Table 2
The Limits for the Socio-economic Scores

ABCDE category	Socio-economic score of a household		ABCDE category	Socio-economic score of a household	
	From	To		From	To
A	1.38	-----	C3	.87	.96
B	1.18	1.38	D1	.74	.87
C1	1.06	1.18	D2	.63	.74
C2	.96	1.06	E	-----	.63

In this case, category A contains households that are at least 1,375 times better socio-economically situated than the average given by category C2, whose limits are approximately from.96 to 1.06. The categorization of the socio-economic score in order to obtain the ABCDE categories in the SPSS syntax and the possibility of compiling regression models valid for the year 2021 (with different limits compared to the 2020 calibration highlighted yellow) are as follows:

if (score > .63) ABCDE = 7, if (score > .74) ABCDE = 6, if (score > .87) ABCDE = 5, if (score > .96) ABCDE = 4, if (score > 1.06) ABCDE = 3, if (score > 1.18) ABCDE = 2, if (score > 1.38) ABCDE = 1. Overall, the respondent was assigned a value of 1 – 8, where the lower the value, the higher the socio-economic status of the household.

Research Results

Data analysis was done by compiling a regression model, which included the following 12 factors: F1 – Satisfaction with distance learning, F2 – Difficulty factor for full-time form, F3 – Evaluation factor for full-time form, F4 – Activity factor for full-time form, F5 – Difficulty factor for combined form, F6 – Evaluation factor for combined form, F7 – Activity factor for combined form, F8 – Perception of distance learning through negatives, F9 – Perception of distance learning through positives, F10 – Socio-economic status, F11 – Age, F12 – Length of practice in education. The values of the descriptive analysis are given in the following table 3.

Table 3
Descriptive Analysis for Individual Factors

	M	*Md*	*Mo*	*SD*	max	min
F1	23.26	24	30	8.19	40	8
F2	11.92	12	12	4.21	21	3
F3	10.49	11	12	4.13	21	3
F4	10.66	11	12	3.08	21	3
F5	12.39	12	12	4.38	21	3
F6	11.14	12	12	4.19	21	3
F7	11.44	12	12	3.27	21	3
F8	31.32	30	27	9.83	60	12
F9	16.71	16	8	7.29	40	8
F10	4.49	5	6	2.02	8	1
F11	26.72	23	21	8.52	59	19
F12	3.71	0	0	6	45	0

In order to be able to use regression models, it was necessary to verify the partial properties of the measured data. The estimation of homoskedasticity was performed on the basis of scatter plots. This comparison shows no systematic dependencies. The error component has a constant variance (for each observation the respective vector component has the same variance – so-called homoskedasticity can be assumed. With the exception of the factor F1-F9 ($r = .67$, $p < .001$), the correlation is low in all cases and satisfies the condition set out above. Here the absolute value of the Pearson correlation coefficient is less than .80, it shows collinearity is very less likely to exist. The coefficients for multiple correlation are shown in the following table 4.

Table 4
Correlation Matrix for Individual Factors

	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12
F1	-.27	-.35	-.32	.47	.54	.50	-.58	.67	.02	-.18	-.02
F2		.59	.46	-.07	-.18	-.15	.24	-.25	.04	.05	.01
F3			.65	-.23	-.23	-.20	.30	-.28	.00	.04	-.02
F4				-.21	-.20	-.17	.30	-.27	-.02	-.03	-.03
F5					.71	.58	-.36	.37	.06	-.09	.00
F6						.74	-.41	.44	.03	-.25	-.03
F7							-.39	.39	.04	-.29	-.05
F8								-.38	.00	.14	.00
F9									.05	-.10	-.03
F10										-.05	-.03
F11											.17

Value R = .79 shows there is a positive correlation between the variables. The $R^2 = .62$ shows that 61.90 % of the movement in the dependent variable can be explained by the independent variables and the rest 38.10 % remains unexplained ($R^2 = .62$; F (11, 1267) = 187.18, $p < .001$; SEM: 5.08). The adjusted $R^2 = .62$ gives the idea of how well the model generalizes.

It is clear from the table that a total of four variables are not significant for the model. The value of VIF is $1 < VIF < 5$; it specifies that the variables are moderately correlated to each other. The small values of VIF corresponding to the variables show that there is no problem of collinearity. In the further analysis, those regressors that prove to be insignificant at at least 5 % level of significance are omitted. These regressors included F2 – Difficulty factor for full-time form, F4 – Activity factor for full-time form, F10 – Socio-economic status, F11 – Age, F12 – Length of practice in education (table 5).

Table 5
Multiple Regression (Forward Stepwise Method) on Distance Education Satisfaction

	β	*β* ± SE	B	B ± SE	t(628)	*p*
Intercept			20.15	1.30	15.51	< .001
F2	-.01	.02	-.02	.04	-.55	.59
F3	-.07	.03	-.13	.05	-2.56	< .05
F4	-.02	.02	-.06	.06	-.93	.35
F5	.07	.03	.14	.05	2.88	< .01
F6	.08	.03	.16	.06	2.68	< .01
F7	.09	.03	.22	.07	3.31	< .001
F8	-.29	.02	-.24	.02	-14.24	< .001
F9	.43	.02	.48	.02	20.92	< .001
F10	-.01	.02	-.05	.07	-.64	.52
F11	-.04	.02	-.04	.02	-1.97	< .05
F12	.00	.02	.00	.02	.20	.84

Discussion

The aim of the study was to find out factors, which influenced the satisfaction with distance learning among college students from different universities of Czech Republic. The satisfaction with distance learning was positive among college students. These findings were in concordance with similar studies concerning the same problems. For example, according El Refae et al. (2021), students were more satisfied with distance learning due to its higher amount of advantages and opportunities. The similar results were possible to find in other studies like Baber (2020) or Holzer et al. (2021). This result was possibly caused by a quick and good preparation of universities on the unknown situation, which was the pandemic situation and suddenly closing off face-to-face learning and jump to distance education. Also, the professional skills of college teachers to change the teaching from full-time to distance education process. This activity was demanding and time-wasting and required amount of effort to prepare appropriate electronic environment for the distance learning of students. Without this, the positive evaluation of distance learning students from different types of faculties would not be possible.

The factors of evaluation for full-time and distance learning were significant. The presumptions were confirmed because the evaluation of full-time learning negatively correlated with the significance of a distance learning factor. And the factors like evaluation, activity, and difficulty of distance learning positively correlated with the significance of distance learning. These correlations/relationships were studied only marginal in the second way around the main study. However, it is possible to find some paths about similar findings presented in the study of Fojtik (2015), Griffiths (2016). As Fojtik (2015) quoted students had a feeling that distance education was not so demanding. Then they are surprised that they have to complete several exercises or corresponding tasks during the semester. Fojtik (2015) also wrote that the level of success was higher among distance students. According to this fact it is possible to say that distance learning was not perceived as a demanding activity because in home environment that was a classroom for students, the climate for the listening of lectures and also for learning activities was more pleasant. Students have got the possibility to use different learning aids, which were not so accessible during full-time learning process, where students had to focus attention on the lecturer and they did not have access to different manners of help through teaching process like access to internet, using of mobile phones, etc. On the basis of this, the level of difficulty was decreasing, also the possibilities of evaluation are changing with the respect of transition from face-to-face learning process to distance. Teachers did not have so many control mechanisms as it was during full-time teaching process. So, it was easy for students to achieve better evaluation during distance learning. This idea was supported by other studies, like Hobson and Puruhito (2018) or Stojanovic et al. (2021), where it is also possible to find hidden ideas about different ways, why students achieved better scores on tests or in the exams during distance learning. Here there are for example, better possibilities to use learning aids, lack of nervousness, cooperation with schoolmates, etc.

The perception of distance learning through positives significantly correlates with student satisfaction in online classes. The similar results were possible to find in the study of Mucci-Ferris et al. (2021) or Rizun and Strzelecki (2020). These findings are connected with the previous paragraph because of the possibilities of pros. Students assured that distance learning era discovered many possibilities how to make their study easier. Also, there is a fact of the presentation of learning material from the side of the teacher. There is a big chance that this activity is different from face-to-face. Teachers are not eligible to control all activities of students during the teaching process, which is conducted through different electronic media. So, students could through different social sites, message channels, and other forums. These forms could not be visible for teachers through video-cameras. Also, during tests or exams it can be easier for students to make academic cheating, which is more possible to do in your own room. All these facts could lead to more positive view of distance learning.

The age had a significant effect on the satisfaction with distance learning. The older respondents had lower satisfaction with distance learning in comparison with younger ones. The similar result was found out by the authors Barczyk et al. (2017), where the younger respondents higher valued clarity and appropriateness of the assessments and clear criteria for grading. Also, they placed a high value on the tools and media that support learning objectives and classmate interactivity. Similar results were also published in the study of Botha and Coetzeee (2016). This is the reason why older respondents are more restrained with the using of electronic tools for the educational purposes and are not so satisfied with the distance learning. Maybe, there is a little bit of fear with the using of electronic devices during distance learning. On the basis of this fact, they are not willing to use special functions of hardware and software, which are connected with the using of electronic media during the learning process. This fact can lead into stress conditions during the learning process, and it can have a big impact on the evaluation of satisfaction with distance learning.

Conclusions and Implications

According to the findings presented in the previous chapters, it is an obvious difference between full-time and distance learning. The respondents perceived distance learning as not so demanding, and they are satisfied with this approach of learning. It could be caused by different requirements during distance learning, which made the process of learning and teaching easier, so students achieved better scores in tests and exams and then they were satisfied with this kind of learning. So, the processes of control mechanisms could be more sophisticated due to equalization of distance and full-time learning achievements. Age of respondents also manifested as a significant factor, so the way of distance learning should be more accessible and user-friendly for the higher age cohorts. However, this process is in the IT departments of universities. The socio-economic status was not shown as a significant factor because in the Czech Republic conditions, this variable is important in terms of the success of pupils in primary schools as well as students in secondary schools. On the basis of this, the age together with SES created common variables, where the effect of SES was eliminated. In the further research the focus should be focused more on psychological aspects of using distance learning, like the level of stress conditions, which can influence the perception of distance learning. Also, the comparison of pupils of high schools with university students in the aspects of distance learning could be interesting.

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Declaration of Interest

The authors declare no competing interest.

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THE PREDICTIVE EFFECT OF TOXICITY ON SATISFACTION WITH LIFE AT SCHOOL

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Abstract

The effect of toxicity on satisfaction with life at school affects many variables. As parts of school culture, satisfaction and toxicity are related concepts. This study aims to determine the predictive effect of toxicity on satisfaction with life at school. In Turkey, no study has been found to be conducted about the relationship between organizational toxicity and satisfaction with life. Method of the research: This was a descriptive study based on the correlational survey model. In this study, it was supposed to determine the effects of teachers' demographic characteristics (gender, alma mater, professional seniority, and number of teachers in the school) and toxicity perceptions on satisfaction with life. The study group consisted of 1600 teachers working at 54 secondary schools in Sivas city center. Based on the calculation made, a sample of 223 teachers representing the population was created. The dependent variable of the study was teachers' satisfaction with life. Stepwise regression was used as a multiple regression analysis technique. In this regression analysis, a linear structure of the relationship between one dependent and more than one independent variable was tested. The results showed that the toxicity avoidance behaviors of teachers positively affected their perceptions of satisfaction with life. It was teachers' displaying conflict behaviors (β= -,226) regarding toxicity. There was a decrease in the satisfaction with life of teachers who ventured conflict. Likewise, there was a negative effect (β= -184) between the level of narcissistic behavior in the organizational environment and the level of satisfaction with life. The satisfaction with life levels of teachers who thought that narcissistic behaviors were exhibited in the organizational environment decreased. A positive relationship was found between the fourth ranked variable resistance (β= ,149) and satisfaction with life. Teachers' resistance to painful toxic situations increased their level of satisfaction with life.

Keywords: *school teachers, organizational toxicity, toxic organization, satisfaction with life*

Introduction

Schools are educational institutions created to achieve predetermined special goals and achieve these goals through stakeholders. The stakeholders of schools are school administrators, teachers, and other employees. For achieving the goals of the organization, it is expected to be a balance between the goals of the organization and the goals of the employees. The balance between the request and needs of its stakeholders and the needs of the organization may sometimes be disrupted. School administrators and senior administrators have to take into account, manage and evaluate the requests and needs of other employees of the organization. Intoxication or toxicity can be defined as a state of extreme disruption of the balance between the demands of stakeholders and the goals of the organization. Toxicity can be seen as the deterioration of harmony among the employees of the organization, the decrease in the morale and motivation of the employees, and the loss of mutual understanding. This situation may

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cause a decrease in morale and motivation of employees in organizations and in productivity, and affect their satisfaction of life levels.

Educational excellence is significantly linked to the unique cultures of schools (Deal & Peterson, 1999). Culture is the underground stream of norms. Informal expectations and values, such as habits, beliefs, customs, and rituals that form over time as people work together, solve problems, and face challenges shape how people think, feel, and act in schools. This highly lasting web of influence connects the school and makes it special. It is up to school leaders (principals, teachers, and often parents) to help identify, shape, and sustain strong, positive, and student-centered cultures. Without these supportive cultures, reforms will disappear, and student learning will weaken (Peterson & Deal, 2011). It is also possible for schools to become unproductive and toxic over time. Lack or loss of goals in schools can increase hopelessness.

The concepts of toxic and toxicity are mostly used in science and health sciences. According to the Turkish Language Association (TDK, 2013) toxic means "poisonous, noxious substance". Furthermore, in Turkish Language Association (2015), it is defined as "misery, suffering due to any external factor" and figuratively as "offending, dismal, hurtful, touching, bad". On the other hand, Gangel (2008, p.2) states that "It is caused by a toxin or a poison having the capacity to cause injury or death". Toxicity can be explained as "contamination of the environment with snake venom, alcohol, or the release of heavy metals into the environment" (Gangel, 2008, p. 2).

Organizational toxicity was defined as "situations that cause employees to suffer and to experience problems in their work environments. They negatively affect their morale and motivation, and reduce their interest in work" by Griffin and Glew (1996); as "destructive pains on the self-confidence and dignity of employees in institutions" by Pelletier (2009); as "prevalent, profound, and negative emotions that separate individuals from their jobs, colleagues, and institutions and deenergize them" by Frost and Maitlis (2003, p.13-14); as "situations that cause harm or injury to institutions, are harmful to employees, cause distress and disadvantages" by Kasalak and Aksu (2016, p. 677).

Toxic Organization was explained as "an organization where employees move away from cooperation, act in line with their own interests, are not able to reach satisfaction and play a significant role in the process of organizational decisions, and an organization having a stressful atmosphere which acts outside of its own goals." (Kırbaç, 2013, p.10). Toxic organizations are in a state of confusion and may have destructive features. It can be said that the level of harmony and trust among the employees of a toxic organization is to decrease. Toxic organization is defined as "an organization that is poisonous, unincorporated, destructive, exploitative, dysfunctional, and which includes bad behaviors that can spread easily" (Kırbaç, 2013, p.34).

In the literature, organizational toxicity has been examined in four dimensions on the basis of behaviors of organizational members. "Studies focusing on behavior-based approaches in the formation of organizational toxicity described toxic organization members as narcissistic (Lubit, 2003; Riley et al., 2011; Schmidt, 2008), aggressive (Carlock, 2013; Leet, 2011; Pelletier, 2009), strict (Gangel, 2007; Lubit, 2003; Schmidt, 2008) and unethical (Lubit, 2003)" (as cited by Kasalak & Aksu, 2016, p. 677). While narcissistic behaviors are such as self-admiration and contempt for others, aggressive behaviors are attacking members' personalities, forcing employees to take sides, slandering, etc. Narcissists look at things from their own perspective and tend to look down on others. Strict behavior can be explained as treating the members of an organization in an unkind manner. Employees who act strictly or harshly are individuals that ignore rules of courtesy and act rudely without considering the feelings of others. Unethical behaviors are carrying out duties outside the legal legislation, providing personal benefits, neglecting work or shirking. It can be said that employees who display unethical behavior tend to place their personal interests before the interests of the organization. The level of toxicity in an organization can negatively affect satisfaction with life and health of the employees of an organization. It may cause the organization to experience entropy. This situation may prevent the organization from achieving its goals which helps its existence. The institution manager has to understand, evaluate, intervene, correct and improve this situation of poisoning or toxicity. In terms of organizational health and life, it can be ensured that employees' behaviors of satisfaction with life, not their toxic behaviors, can be increased.

Satisfaction with life of those working at schools is the second concept of this study and is directly opposite of toxicity. The more negative the toxicity contains, the more satisfaction with life expresses its opposite. The concept of life satisfaction constitutes one of the three dimensions of subjective well-being, together with positive and negative effects (Andrews & Withey, 1974). While positive and negative effects constitute the emotional/affective component of subjective well-being, life satisfaction constitutes the cognitive/judgmental component of subjective well-being. (Diener, et al. 1985, p. 71).

Satisfaction with life is "a situation or a result obtained by comparing a person's expectations with what he/she has" according to Haybron (2004, p.3), "a positive evaluation of one's whole life based on the criteria set by oneself, and an important element of comprehensive happiness" according to Diener, et al. (1985), "the sum of a person's beliefs and evaluations about life, or a person's general attitude towards life" according to Rice, et al. (1992, p. 156). Keser (2005) explains the factors affecting satisfaction with life as creating a positive identity, meaningful life, happiness, perception of success, satisfaction in relationships, physical well-being, and economic competence. According to Appleton and Song (2008), the components of life satisfaction are; (1) the income level of the individual, (2) his/her professional and social status, (3) the opportunities, and social mobility he/she has, (4) his/her prosperity status, (5) the current government policy, and (6) the environment, family, and social relations.

The main theme of our study is the relationship between toxicity and satisfaction with life at school. These concepts seem to be completely opposite. In recent years, considerable studies have been conducted on toxicity, toxic organization (Arar, et al. 2019, Bayrakçı, 2017; Bektaş & Erkal, 2015; Demirdağ, 2018; Frost, 2003; Kasalak & Aksu, 2016; Uysal, 2018), and toxic leadership (Bahadır & Kahveci, 2020; Bozkurt, et al. 2020; Çetinkaya & Ordu, 2018; Demirel, 2015; Kahveci, et al. 2019; Kasalak & Aksu, 2016; Kırbaç, 2013; Küçük & Demirtaş 2021; Pelletier, 2012; Tepe & Yılmaz 2020; Yalçınsoy & Işık, 2018; Yavaş, 2016). In addition, scale development studies (Bektaş & Erkal, 2015; Çelebi, et al. 2015; Kasalak, 2015) have been carried out in the field of toxic leadership. However, it was understood that only a few of them were on the relationship between toxicity and satisfaction with life in Turkiye. This research was carried out to fill the gap in this field and to support practitioners. Thus, the general purpose of this study was to determine the predictivity of toxicity on satisfaction with life at school.

Research Methodology

General Background

This was a descriptive study based on the relational screening model. In the study, it was supposed to determine the effects of teachers' demographic characteristics (gender, alma mater, professional seniority, and number of teachers at school) and toxicity perceptions on satisfaction with life.

Population and Sample

The study group included 1600 teachers working at 54 secondary schools in the city center of Sivas. The research was carried out between January and June 2021. Since there were

1600 teachers in total in the study population, it was determined that the number to be included in the sample representing the population was 213 as a result of the calculation made with the formula n= Nt2 pq/d2 (N1)+t2 pq in accordance with the population-sample relationship.

The scales were administered to the teachers in the study group under the supervision of the researchers. After eliminating the extreme and missing values from the scales administered, 223 scales suitable for processing were assessed. Numerical data about the sampling was given in Table 1.

Table 1
Numerical Data on the Study Group

Demographic Features	Classification	Frequency	Percentage (%)
Gender	Female	120	53.8
	Male	103	46.2
Alma mater	Faculty of Education	174	78.0
	Other	49	22.0
Number of teachers at school	12 and below	70	31.4
	13-25 teachers	94	42.2
	26 and above	59	26.5
Total		223	100

Instruments and Procedures

The data of the study were collected via the scales of “Organizational Toxicity” and “Satisfaction with Life”. The Personal Information Form consisted of variables such as gender, alma mater, professional seniority, and the number of teachers at school.

Organizational toxicity scale: The scale which was developed by Kasalak (2015) and included Measurement Tool for Perceived Organizational Toxicity with 16 items in the first part, Measurement Tool for the Perceived Effect of Toxicity with 12 items in the second part, and Measurement Tool for Coping with Toxicity with 12 items in the third section.

The components emerged as a result of the EFA performed in the development of the measurement tool of Perceived Organizational Toxicity (POT) were entitled as Toxicity Stemming from Narcissistic Behaviors (explained variance: 47.836% eigenvalue: 7.654), Toxicity Stemming from Aggressive Behaviors (explained variance: 8.566% eigenvalue: 1.371), Toxicity Stemming from Unethical Behaviors (explained variance: 7.444% eigenvalue: 1.191), and Toxicity Stemming from Strict Behaviors (variance explained: 6.634% eigenvalue: 1.057). The overall internal consistency coefficient (Cronbach’s Alfa) of the POT measurement tool was found to be .938. The internal consistency coefficients regarding the components (Cronbach’s Alpha) were .880, .845, .834, and .854 respectively. These values ensured that the reliability level of the POT was sufficient.

The components emerged as a result of the EFA performed in the development of the measurement tool of Perceived Effect of Toxicity (PET) were entitled as Revelation (variance explained: 55.773 eigenvalue: 6.693) Repetition of Negative Emotions (variance explained: 11.890% eigenvalue: 1.427) and Disengagement (variance explained: 9.103% eigenvalue: 1.092). The overall internal consistency coefficient (Cronbach’s Alpha) of the PET was calculated as .927. The internal consistency coefficients regarding the components (Cronbach’s Alpha) were .890, .915, and .892 respectively. These values ensured that the reliability level of the POT was sufficient.

The components emerged as a result of the EFA performed in the development of the measurement tool of Coping with Toxicity (CWT) were entitled as Resistance (explained variance: 27.571% eigenvalue: 3.309), Avoidance (explained variance: 15.016% eigenvalue: 1.802), Conflict (explained variance: 13.08% eigenvalue: 1.621), and Social Support (explained variance: 9.215% eigenvalue: 1.106). The overall internal consistency coefficient (Cronbach's Alpha) of the CWT was found to be .749. The internal consistency coefficients regarding the components (Cronbach's Alpha) were .738, .691, .650, and .664 respectively. These values ensured that the reliability level of the CWT was sufficient.

The Satisfaction with Life Scale (SWLC): The original satisfaction with life scale was developed by Diener (1985) and adapted into Turkish by Koker (1991). The five-item scale is scored from 1 to 7. The reliability of each item was found to be correlated with the total score as follows: item 1: .73, item 2: .71, item 3: .76, item 4: .75, and item 5: .80.

Data Analysis

SPSS 21 program was employed in the analysis of the research data. While the dependent variable of the research was teachers' satisfaction with life, the independent variables were the components of the organizational toxicity scale, which were Perceived Organizational Toxicity (sub-components: narcissistic, aggressive, unethical, and strict behaviors) Perceived Effect of Toxicity (sub-components: revelation, repetition, disengagement) and Coping With Toxicity (sub-components: resistance, avoidance, conflict, and social support).

In the study, stepwise regression was performed as a multiple regression analysis technique. In this regression analysis, a linear structure of the relationship between one dependent and more than one independent variable was tested.

$Y= a+b1x1+b2x2$

Y= The dependent variable X= Independent variable

a: Value of Y when X=0 (constant)

b: Average amount of change in Y caused by 1 unit change in X (regression coefficient)

In the stepwise regression, the highest predictive variables are added to, and the lowest ones are removed from the model. Additionally, the predictive variables that have a significant contribution to the prediction are included in the model, and the regression equality is achieved. For enabling this, the "forward" method should be chosen as the analysis technique. In the forward method, the dependent variable and the predictor variable with the highest level of relationship with it are first included in the model, and then the others are included based on the level of relationship (Kalayci, 2010; Karasar, 2020; Secer, 2013).

Data Preparation

While starting the multiple regression analysis, the outliers were removed because the analysis was sensitive to them. The values between -3 and +3 were removed, and the data were made ready for processing. According to Kalaycı (2010), skewness values are expected to be between -3 and +3 and kurtosis values are expected to be between -2 and +2.

In order to test the suitability of the data for processing, the normality assumptions of the data must be checked first. For this reason, the skewness and kurtosis coefficients were found, and it was seen that normality was provided except for the three sub-components (aggressive, unethical, and strict behaviors). Therefore, these three sub-components were not included in the analysis as predictive variables. The skewness and kurtosis values regarding the components of organizational toxicity were as follows. The sub-components of Perceived Organizational Toxicity: narcissistic behavior skewness value was 1.55, and kurtosis value was 2.03; aggressive behavior skewness value was 1.84, and kurtosis value was 3.78; unethical behavior skewness value was 2.18, and kurtosis value was 6.07; and strict behaviors skewness value was 2.30, and kurtosis value was 6.46. The sub-components of Perceived Effect of Toxicity: revelation skewness value was ,742, and kurtosis value was -,430; repetition skewness value was 722, and kurtosis value was -,188; disengagement skewness value was 1.11, and kurtosis value was ,574. The sub-components of Coping with Toxicity: resistance skewness value was -1.46, and kurtosis value was 2.01; avoidance skewness value was -,51, and kurtosis value was -,73; conflict skewness value was ,14, and kurtosis value was -,50; social support skewness value was -,81, and kurtosis value was ,64. Skewness and kurtosis values for Satisfaction with Life were -,90 and ,97, respectively. Based on these findings, eight different variables were included in the analysis as predictive variables.

There are some other basic assumptions in multiple regression analysis, one of which is to reach a sufficient number of samples. Accordingly, Stevents (1996) stated that there should be 15 subjects per predictive variable. In a stepwise regression analysis, the fact that the number of predictive variables to be included in the analysis is 8 indicates a sample size of at least 120. Thus, the number of subjects was compatible with this assumption. In addition, it was revealed that the predictor intervariable correlation was between .092 and .786 at the highest, and no correlation was above 90. According to the results of the bilateral correlation analysis, no high correlation was found among the predictive variables.

In order to test the relationship between teachers' perceptions of organizational toxicity and their satisfaction with life, "no autocorrelation", which is one of the assumptions of the multiple linear regression model, was also tested (to be able to perform multiple regressions). Durbin-Watson coefficient was examined for autocorrelation test. As a result of the test, it was seen that the Durbin-Watson coefficient (DW=2.089) was between 1.5 and 2.5, and this value indicated that there was no autocorrelation.

To ensure that there was no multicollinearity, another assumption, Tolerance, VIF and CI values were calculated. Tolerance and VIF values of the regression model were as follows; Tolerance value=.718 to .984, VIF values=1.05 to 1.39. Results did not indicate multicollinearity (Tolerance value should not be less than .10 in all and VIF values should not be less than 10). In the "Collinearity Diagnostics" table, no multicollinearity was observed since there was no CI value greater than 30 (Condition Index Values = 5.82 and 13.30). (Kalayci, 2010).

Research Results

Findings of the predictor of toxicity on life satisfaction in schools according to some variables. Under this heading, the results of stepwise regression analysis testing the effects of narcissistic behaviors, sub-component of organizational toxicity; of revelation, repetition, and disengagement, sub-components of perceived effect of toxicity; of resistance, avoidance, conflict, and social support, sub-components of coping with toxicity on life satisfaction were examined. It is essential that the correlations between independent variables are low in multiple regression models. According to Kalaycı (2010), correlations between independent variables are expected to be below .80. If the correlation value is above .80, it is an indication of the multicollinearity problem.

Table 2
Model Summary

				Change Statistics				
	R	***R***^{2}	**Adjusted *R***^{2}	Estimated Standard Error.	*R*^{2}	*F*	*p*	Durbin-Watson
1	.206[a]	.042	.038	.98085	.042	9.749	.002	2,089
2	.302[b]	.091	.083	.95763	.049	11.849	.001	
3	.350[c]	.122	.110	.94326	.031	7.756	.006	
4	.377[d]	.142	.126	.93487	.019	4.948	.027	

a. predictor variable : (Constant), avoidance
b. predictor variable : (Constant), avoidance, conflict
c. predictor variable : (Constant), avoidance, conflict, narcissistic behaviors
d. predictor variable : (Constant), avoidance, conflict, narcissistic behaviors, resistance
e. dependent variable : satisfaction with life

Four models emerged as a result of stepwise regression. In the first model, the predictive variable was only avoidance, while in the second model, conflict was the predictive variable as well as avoidance. In the third model, along with these variables, the variable of narcissistic behaviors was included in the model. In the last model, all the predictive variables, the subject of the research, were included in the model.

When the model was examined as a whole, R^2 in the table showed that the dependent variable, namely satisfaction with life, was explained by the independent variables. Accordingly, while the independent variable of avoidance, the sub-component of ***coping with toxicity***, explains alone 4% of teacher satisfaction with life, the sub-components of avoidance and conflict together account for 9%; avoidance, conflict and narcissistic behaviors account for 12%; avoidance, conflict, narcissistic behaviors, and resistance explain 14% of satisfaction with life. When the ANOVA results of the model were examined, it was seen that the F values varied between 9.749 and 11.038, and there was a significant difference at all levels. Variables that were significant in this model had a predictive effect on satisfaction with life. It was the fourth model with the highest percentage of explanation.

Table 3

Results of the Forward Regression Analysis on Predictivity of Teachers' Levels in the Toxicity-Related Sub-Components of Avoidance, Conflict, Narcissistic Behaviors, and Resistance on Their Satisfaction with Life

B		Non-standardized coefficients		Standardized coefficients	t	p
		SE		Beta		
1	Constant	-.579	.197		-2.943	.004
	Avoidance	.169	.054	.206	3.122	002
2	Constant	-.146	.230		-.633	.527
	Avoidance	.231	.056	.281	4.137	.0001
	Conflict	-.235	.068	-.234	-3.442	.001
3	Constant	.147	.250		.589	.557
	Avoidance	.241	.055	.292	4.364	.0001
	Conflict	-.198	.068	-.197	-2.899	.004
	Narcissistic Behaviors	-.296	.106	-.181	-2.785	.006
4	Constant	-.286	.315		-.909	.364
	Avoidance	.212	.056	.258	3.783	.0001
	Conflict	-.227	.069	-.226	-3.283	.001
	Narcissistic Behaviors	-.301	.105	-.184	-2.858	.005
	Resistance	.153	.069	.149	2.224	.027

According to the generated model given in Table 3, in the second step model, from the highest Beta value to the lowest were avoidance (β= .281) and then conflict (β= -.234). In the third step of the model, avoidance (β= .292), conflict (β= -.197), and narcissistic behaviors (β= -.181) were sorted according to the Beta rank. In the fourth model, it was listed as avoidance (β= .258), conflict (β= -.226), narcissistic behaviors (β= -.184), and resistance (β= .149). As it can be seen, regression equation regarding the fourth model with the highest percentage of explanation was formed as follows:

Satisfaction with Life Level= -.286 +.212 Avoidance -.227 Conflict -.301 Narcissistic Behaviors +.153 Resistance

According to this model equation, teachers' avoidance behaviors caused an increase of 0.212 in their perceptions of satisfaction with life. A one-unit increase in their conflict behaviors was associated with a -.227-unit decrease in their satisfaction with life. A one-unit increase in narcissistic behaviors caused a -.301 decrease, while a one-unit increase in resistance behaviors caused a .153 increase. The variable with the most important effect on teachers' satisfaction with life was avoidance.

Discussion

In this study, it was aimed to examine the effects of the components of perception of toxicity experienced at school, of perceived effect of toxicity, and of coping with toxicity on teachers' perceptions of life satisfaction. Organizational toxicity and its sub-components are as follows: Perceived Organizational Toxicity (sub-components: narcissistic, aggressive, unethical, and strict behaviors), Perceived Effect of Toxicity (sub-components: revelation, repetition, and disengagement), and Coping with Toxicity (sub-components: resistance, avoidance, conflict, and social support). Accordingly, in the study, the levels of 8 sub-components to predict teachers' satisfaction with life were investigated. *Unethical and strict behaviors,* which did not show normal distribution, were not included in the analysis. In the four models, where the eight sub-components were significant for predicting teachers' satisfaction with life, it was seen that the *p* values were between 0.002 and 0.027, and the *p* was less than .05. In the research, it was seen that the fourth model with the highest explanation value (R2 = .126) explained the teachers' perceptions of life satisfaction at a level of 13%. When all the independent variables were considered together, it was understood that the highest effect value was between avoidance and perception of satisfaction with life (β= .258). In other words, teachers' behaviors of avoidance from toxicity positively affected their perception of satisfaction with life. The second highest effect value was that the teachers showed conflict behaviors (β= -.226) related to toxicity. Accordingly, teachers' conflict behaviors affected their perceptions of satisfaction with life negatively. That is to say, there was a decrease in satisfaction with life of the teachers who ventured a conflict. Similarly, there was a negative correlation between the level of exhibiting narcissistic behaviors in the organizational environment and the level of satisfaction with life (β= -.184). In other words, satisfaction with life levels of teachers who thought that there were narcissistic behaviors in the organizational environment decreased. A positive correlation was found between resistance (β= .149), one of the fourth model variables, and satisfaction with life. Teachers' resistance to painful toxic situations increased their levels of satisfaction with life.

Kasalak and Aksu, (2016, p. 676) identified views on organizational toxicity as narcissistic, aggressive, unethical, and strict behaviors, and views on the perceived effects of toxicity as revelation, repetition of negative emotions, and disengagement, while they asserted the strategies for coping with toxicity as avoidance, resistance, social support, and conflict. When compared with the results of this research, it can be said that resistance and avoidance have a positive effect on satisfaction with life. Kasalak & Aksu, in their study, also defined resistance and avoidance as ways of coping with toxicity. It can be claimed that satisfaction with life is positively affected when the increase in satisfaction with life is in the form of avoidance and resistance, respectively.

Uysal (2018, p. 57-58) revealed that, among the strategies for coping with toxicity, men adopt the conflict strategy more than women, while women adopt the social support strategy more than men. In this case, it can be seen that the strategies of conflict and social support are used as a shield against toxic effects. It can be expressed that this situation has a positive effect on the employees' life satisfaction.

The research findings indicated by Kasalak (2019, p. 1283) as "perceived organizational toxicity significantly predicts the variables of job satisfaction and affective commitment" and by Demirdag (2018, p.1319) as "the effect of organizational toxicity is higher than the level of coping with toxicity of academic staff in higher education and there is a positive and significant relationship between perceived organizational toxicity and the perceived effects of toxicity" are similar to the results of our study. Moreover, there are different studies with similar results (Kasalak, 2015; Kırbaç, 2013; Reyhanoğlu & Akın, 2016).

In the literature, it was found that "teachers do not agree that school principals exhibit toxic leadership behavior; although they hardly ever experience a decrease in emotional exhaustion and a decrease in the sense of personal accomplishment, they never experience depersonalization, and a low-level significant relationship was found between all sub-components of burnout and the ignorance sub-component of toxic leadership and with the overall" (Çetinkaya and Ordu, 2018, p. 15) ; "the most important factor causing organizational toxicity is the administrators in the context of the main factor" (Arar, et al. 2019, p.57); "administrators' behaviors of toxic leadership affect teachers' organizational commitment negatively, and toxic leadership behavior is an important predictor of organizational commitment" (İlhan & Çelebi, 2021, p. 202); "negative mental state is a significant predictor of school environment" (Tepe & Yilmaz 2020, p.3373); "toxic leadership directly and negatively affects satisfaction resulting from the leader, job, wage and colleague." (Schmidt, 2008; as cited by Kasalak, 2019, p.1287). The research findings are consistent with these data. Similarly, in the study conducted by Bahadır and Kahveci (2020, p.861), it was concluded that "teachers have high perceptions of psychological capital; on the other hand, their toxic leadership perceptions are low, and there is a low and significant negative correlation between teachers' psychological capital and toxic leadership perceptions". Bozkurt et al. (2020, p. 704) stated "that high-level managers working in the Ministry of National Education mostly show toxic leadership behavior, that the staff have a medium level of organizational commitment, that they have a very low level of organizational trust, that there is a negative medium-level relationship between toxic leadership and organizational trust, a low negative relationship between toxic leadership and organizational commitment, and a positive moderate relationship between organizational commitment and organizational trust".

It was concluded by Bahadır & Kahveci (2020, p.861) that "there is a negative and low-level significant relationship between teachers' psychological capital and toxic leadership perceptions", and by Kucuk and Demirtas that "psychological capital has a mediating effect between toxic leadership and school effectiveness". The research data are consistent with these data. Furthermore, it was revealed by Alibekiroglu, et. al. (2018, p. 1) that "there is a positive and significant relationship between satisfaction with life and resilience, satisfaction with life and self-understanding, and self-understanding and resilience". It was also reported by Demir, et al. (2021, p.192) that there is a positive and moderate relationship between quality of life and satisfaction with life, a positive and moderate relationship between quality of life and psychological well-being, and a positive and moderate relationship between satisfaction with life and psychological well-being. Sierra, McCall et al. (2022) found in their study that there is a relationship between burnout and toxic behaviors. Toxicity in interpersonal relationships can reduce employees' engagement with their organization.

Conclusions and Implications

As a result, it was found that toxic perception has a negative effect on satisfaction with life, and there are different ways of coping with this effect. It can be suggested that avoidance behaviors may especially be effective on toxic effects, and that resistance development may also reduce or eliminate toxicity.

The resistance developed by the sufferers together with the avoidance behaviors may reduce the toxic effect on the employees. It was observed that when teachers avoided toxicity, their life satisfaction improved. This situation actually indicated that it also enables teachers to develop resistance through avoidance. For these reasons, it can be claimed that in different school working environments, teachers can adapt to business life by avoiding toxicity.

Teachers can develop resistance by avoiding toxicity. The resistance developed by teachers may appear in the form of adaptation to the environment, flexibility, and self-preservation. Experiencing toxicity causes conditions such as decreased attendance, emotional exhaustion, decreased personal achievement, and compassion fatigue. It is assumed that organizational happiness can be increased by avoiding, avoiding, or managing toxicity. It has also been seen in studies conducted in different work areas that as toxicity decreases, workplace happiness and life happiness increase. Research findings from different parts of the world in different business areas have found a relationship between reducing toxicity and increasing happiness. By reducing the toxic effects in the workplaces, the quality of life in the workplaces can be increased, and it will be better than many variables such as work commitment, attendance, and workplace happiness.

Declaration of Interest

The authors declare no competing interest.

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ONLINE READING IN DIGITAL LEARNING ENVIRONMENTS FOR PRIMARY SCHOOL STUDENTS

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Abstract

Learning environments and teaching methods have been constantly changing over the past decades. As the shift in the learning environment is primarily toward a physical to an online learning environment, this study examines how to enable younger students to select appropriate content for learning in digital learning environments that they can then successfully read and evaluate using appropriate strategies. The study is based on 54 in-depth case studies. Using the Internet reciprocal teaching method (IRT), 54 implementers trained 54 primary school students from first to fifth grade in basic computer skills, Internet information searching, and website navigation, as well as analysing data obtained using the TICA Phase 1, 2, and 3 Checklists, the implementers' report, and the children notes in a text editor. Triangulation of the data in combination with selected statistical methods shows that there are differences in the use of the method between students according to age. While the latter can use an unadopted form of the method, younger students need some adjustments, which are suggested in the light of previous research.

Keywords: *digital literacy, e-reading, primary school, internet reciprocal teaching, online learning*

Introduction

We live in a time of constant and rapid changes that are significantly shaping most areas of human activity, environment, and development. Many try to anticipate trends and tendencies, including educational trends, which can be predicted to some extent by describing models, planning research on future processes, and taking preventive measures (Chan, 2022). One of the current trends is digital literacy in education, which has recently been recognized as one of the basic skills of the 21st century (Siddiq et al., 2017). It refers to all types of digital devices and digital environments (Jin et al., 2020), and is defined in the UNESCO document *A global framework of reference on digital literacy skills for indicator 4.4.2* as: "the ability to access, manage, understand, integrate, communicate, evaluate and create information safely and appropriately through digital technology for employment, decent jobs and entrepreneurship. It includes competences that are variously referred to as computer literacy, ICT literacy, information literacy and media literacy" (Law et al., 2018, p. 6). With all new technologies, the classroom literacy learning is also changing (Leu et al., 2015), including digital literacy (Leu et al., 2013).

Children must navigate in an environment that even adults sometimes cannot navigate well. Zhang and Duke's (2008) study has shown that reading online requires different reading strategies than reading printed texts. The study of strategies for reading online with different purposes in online reading by adults has identified more than 50 reading strategies that readers use depending on the purpose of reading. The online environment offers unimaginable amount of information that anyone can send out into the world (Zhang & Ghorbani, 2020). When reader reads online, he reads from multiple web pages that often present multiple texts, pictures, videos, and other interactive content. The reader is constantly moving between texts

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and pages (Spiro at al., 2015), dealing with a large amount of information from many different type of sources (hypertext, image, video) (Salmerón et al., 2019) and different types of text (websites, travel reports, stories, magazines and the like) (Forzani et al., 2020) and multiple sources require the reader to constantly deal with increasing amount of information, different formats of the information presented, and different quality of the information received, a big part of information online is not fact-checked and published by a reliable source. In online reading, the reader quickly gets lost in hyper-space with the multitude of web pages and links, the integration of more information also means more text formats, and all the information the reader receives must be critically evaluated (Salmerón et al., 2019). There is also a process of connecting, combining, and organizing information that originates from prior knowledge, self-selected online texts, and discussions during searching for information online (Kiili & Leu, 2019). For the reader to be able to successfully select the correct and relevant information from all the information he receives while reading, he must have advanced reading skills beyond those needed to read analog (i.e., printed) texts. Less proficient readers quickly find themselves unable to overcome the aforementioned challenges due to fatigue, decreased reading speed and comprehension, and decreased reading motivation (Cobb, 2017), which many studies have cited as one of the key elements for successful reading in online environments (Forzani et al., 2020; Leu et al., 2017; Goodwin et al., 2019).

The children of the Generation Alpha (also known as the iGeneration) born after year 2010 are considered the most technologically driven demographic, as they are born and grow up with computers, phones, tablets, and apps and do not know life without these devices (McCrindle & Fell, 2020). They are also characterized by access to information anywhere, anytime (Nagy & Kölcsey, 2017; Tootel et al., 2014). Therefore, one would expect them to successfully use the devices and the opportunities they provide. However, this is not the case. The Stavanger Declaration on the Future of Reading (COST E-READ, 2019) has pointed out that one of the most important aspects of digital technologies that affect children in particular is online reading, because information is processed differently when reading on paper than when reading information on a screen. In addition to the need for more in-depth study of reading in a screen environment, participants in the Stavanger discussion have noted that, contrary to expectations, digital natives have difficulties comprehending longer texts when they read on screen. They have therefore recommended that students must be taught strategies that will enable them to read more deeply even when they are on screen and emphasize that teachers and other educational decision makers need to know that the introduction of digital technologies into schools needs to be considered, as it can have a negative impact on children's reading comprehension and critical thinking development. Other research studies have also shown and confirmed that Generation Alpha students do not have sufficiently developed digital literacy skills to successfully participate in digital learning environments (Delgado et al., 2018; Legvart et al., 2021), which presents us with a particular challenge because the literacy skills children will need tomorrow include skills we do not know today (Leu et al., 2013). As a result of the lack of online reading skills, there are also difficulties in reading for learning (Mullis & Martin, 2020; OECD, 2011), which is what online reading usually is (Lin & Ko, 2019).

Research Problem

So how can we help young readers learn in online reading environments? Brun-Mercer (2019) has said the problem should be addressed strategically, otherwise training and practice should be planned for students to help them overcome the challenges and obstacles they encounter in online reading and move toward digital literacy, which the author defines as being "*able to read with sufficient accuracy, fluency, and ease*" (p. 4). Reading literacy has changed and is no longer what it was before the emergence of digital learning environments because, as Leu et al. (2015) have noted, not only are paper-based reading skills required, but also skills associated with searching, evaluating, and integrating online information to come to new knowledge required for new competencies. A method that could provide knowledge to individuals who read and learn online and promotes digital literacy in primary school students, is the Internet reciprocal teaching method (IRT), which was developed with the goal of enabling teachers to prepare their students for 21st century learning and communication (Leu et al., 2008), and which views online reading as a process that involves both traditional and additional skills (Leu et al., 2019). It is based on the already known, tested, and established method of reciprocal learning, which has been shown to be the most effective learning method when students read an offline text. Students work in groups, and the main goal of the method is for students to learn four skills that improve their metacognitive reading comprehension skills: content prediction, asking questions, clarifying the content, and summarizing the content (Palincsar & Brown, 1984). In their meta-analysis study, Rosenshine and Meister (1994) have found a high effect of using this method on students' reading comprehension (effect size coefficient .74). A high effect has occurred regardless of the age, and the effect has been higher when the teacher directly explained and demonstrated the steps of the strategy to the students than when the strategy was used alone.

The main goal of IRT, which was developed for adolescents, is to develop structural elements of student's ability to search for knowledge online and to understand what they read online. The prior knowledge a student needs are basic computer skills, the ability to search the internet and internet navigation skills, while the structural elements of IRT are to ask important questions, locate information, critically evaluate information, synthesize information, and communicate about new knowledge. The student learns this in three steps. In the first step the teacher presents basic computer skills and rules for using the computer in class. In the second step the teacher and the students begin to take responsibility for presenting new strategies and demonstrating, and the third step is about acquiring the ability to independently search for information/knowledge online (Leu et al., 2008).

Research Focus

The aim of the study was to explore whether IRT is an appropriate didactic way to develop competencies for online learning already in primary school. Based on one-to-one teaching directly between an individual single student and one implementer (teacher), which Grasha (2010) has also defined as suitable to develop the ability of learners to work independently, a deeper insight into student digital literacy skills was provided. The research focus was on the following fundamental questions:

1. Which digital competences predominate among younger students?
2. How digital competence develops when implementing the IRT method as an experimental program?
3. What are the peculiarities of implementing the IRT method in primary school, depending on the grade level and gender?

Research Methodology

General Background

In the academic year 2021/2022, from October 2021 to November 2021, the third generation of students of the fourth year of the academic undergraduate program Elementary Education, future teachers from first to fifth or sixth grade in primary school (hereafter implementers), was trained in the use of the IRT method in a 6-hour course. Karakuş and Kılıç

(2022) report that pre-service teachers have a high level of digital awareness, competence, and fluency, therefore, the choice of students from the point of view of prior knowledge was not arguable. Gradually, from November 2021 to January 2022, they applied their knowledge with elementary school students for the first time (the first two generations of students trained in this field did not have the opportunity due to the actions of COVID). The study was designed as a multiple-case study (Eisenhardt, 1989) and is quasi-experimental in design (Cooper, 2009; Kulikowich, 2008). The effects of a program based on the IRT method on student's digital literacy were examined. Qualitative and quantitative research approaches were used to measure the dependent variables. With the help of the collected data, the phenomenon was comprehensively and thoroughly explained and interpreted in the context of the concrete circumstances.

Ethical Procedures

The implementers sought out the students with whom they conducted the IRT program. All participants volunteered to take part in the study. After an introductory presentation of the goals and purpose of the study, the parents of the participants signed consent for the student's participation. Each student was assigned a code that was used in all steps of the study to ensure the anonymity of all participants.

Sample

The opportunity non-random sample consists of children, students of Slovenian primary schools from first to fifth grade, who were available for teaching due to proximity and acquaintance. Data were obtained from 64 case studies, and valid results were obtained from 54 implementers. The students who participated in the study were students from first (6-year-olds) to fifth (10- year- olds) grade: 34 students from first triennium (10 students from first grade (18.2 %), 14 students from second grade (25.5 %), 10 students from third grade (18.2 %)), and 20 students from second triennium (9 students from fourth grade (16.4 %), and 11 students (20.0 %) from fifth grade).

The data was also collected on the gender of the participating students to answer the question whether there were gender differences in the acquisition of computer skills. Most participants were male students – 30 (55.6 %), one tenth more than female students – 24 (44.4 %).

Instrument and Procedures

Students from first to fifth grade were taught one-on-one how to use information and knowledge in the digital environment. Student progress was monitored in a multiple case study and reinforced through triangulation.

First, the implementers were trained in the actual use and implementation of the IRT method. The training was systematic and was conducted in three 2-hours sets (Table 1).

Table 1
Training

Steps	Context	Content
First step (2 hours)	Theoretical background	Reciprocal teaching IRT
Second step (2 hours)	Practical implementation	Reciprocal teaching First phase of IRT with checklist
Third step 2 hours	Practical implementation	Second and third phase of IRT with checklists

The implementers conducted a pre-test (student prior knowledge using TICA Phase 1, 2 and 3 Checklist), which they used to check the prior knowledge of the child they will be working with. TICA checklists are a part of TICA project (Teaching Internet Comprehension Skills to Adolescents) (Leu et al., 2008). For this study, not all data obtained using the TICA checklist were used and interpreted, but only those relevant to the objectives of this research. Using a 3-point scale (1 – do not know yet (0 points), 2 – if someone helps him (1 point), 3 – knows (2 points), the implementers checked the student's prior knowledge within context of three checklists. The first checklist tested the computer basics (14 skills), web searching basics (4 skills), and general navigation basics (3 skills) (all together 42 points). Another checklist tested the student's ability to use at least one search engine (1 skill), use some of the basic search strategies (3 skills), use some of the more demanding search strategies (3 skills), read and understand and critically evaluate search engine results (7 skills), and mark and save a web page to return to when needed (1 skill) (all together 30 points). The third checklist tested knowledge of website navigation (7 skills) and website evaluation (11 skills) (all together 36 points). The reliability of the questionnaire was checked with Cronbach's Alpha coefficient, which is .776 and shows good internal consistency.

Based on the results, the implementers decided which IRT phase to start with and when to move to the next step according to the IRT method. The IRT is designed so that the instructor should move to the next step with all the students in the class when most of the students in their class have mastered the skills within that step. During the one-on-on work, the implementers were instructed to track the student's individual progress and skills, and then decide when the student has sufficient knowledge within the current checklist, such that without that knowledge, the student will be able to successfully acquire the knowledge of the next step while acquiring the skills not yet mastered in the current step. The same checklists were used for ongoing monitoring of student's progress.

Six activities were developed for each step phase of IRT. In carrying out the activity, the implementers considered the student's prior knowledge. During the last training, all the activities designed for the research were also presented to the students. All activities were based on the curriculum objectives for educational period or grade that the selected student was attending (Table 2). When searching for appropriate topics it was also made sure that there was enough content in Slovenian language, and the advantage of individual work was also used when the implementers helped the student translate the content into and from a foreign language (which would not be possible when working in a class with several groups of students).

Table 2
Content

	Phase 1	Phase 2	Phase 3
Activity 1	A personally important question	Reading news in the online newspaper Časoris, which is intended for children, and looking for additional information on the most interesting topic	The student develops his or her own research questions or problems to solve.
Activity 2	Finding answers to student questions about animals	Healthy eating/healthy living	
Activity 3	What would I like to be when I grow up	Miki Muster	
Activity 4	Favourite TV-series	Our planet, our future	
Activity 5	Favourite book	Learning to learn	
Activity 6	My hobby	Holidays at home and in the world	

After each activity, the implementers completed the report – to obtain quantitative data, they completed the checklist according to the current IRT phase, qualitative data were obtained in two ways. The implementers inserted the student's notes, and at the same time the note in the comments, the steps they and the student took, current problems, dilemmas, the student's questions, his answers, observations, etc. With this data collection method, the triangulation of the data was ensured, as it was used both qualitatively and quantitatively (Denzin, 1978, pp. 219–305). The data collected as part of the checklist were initially verified by qualitative data. Later, the Kruskal-Wallis test was used to check whether there were statistically significant differences between groups of independent variables, the Mann-Whitney test was used when two groups were compared. The data obtained in this way were checked again with the help of implementer's notes. The information obtained from the implementers was transcribed, signified, frequencies were determined, rank types were created, and the results were subsequently interpreted.

Data Analysis

Data collection was designed so that all implementers followed the same program, and reporting was done using the same measurement tools (checklists, students' notes, implementers' report), thus ensuring reliability. In the first phase, the data collected by the implementers were checked, some deficiencies were detected, due to which we excluded incomplete reports from further consideration. The second phase followed, in which the data were processed according to the type of questions. Several procedures were used to analyse the results. Basic descriptive statistics were calculated to define the sample. The results of the pre-test were discussed for each checklist, and in the case of the analysis under the aspect of class influence, they were checked with the Kruskal-Wallis test, and in the case of the gender of the participants, with the Mann-Whitney test. In this way, information was obtained on whether there were differences in acquired computer skills as a function of the observed variable. Further analysis was conducted with respect to student progress in digital literacy. Thus, progress was not monitored as progress on an individual checklist, but as the total sum of all digital literacy skills acquired, since the same number of meetings were not held in all classes, with the implementers following the procedure described in the previous chapter. To examine the dependence between dependent and independent variables, a multivariate MANOVA method was used to determine differences between groups. Data on whether there were statistically significant differences in digital literacy acquisition were examined using Wilk's Λ. To determine how dependent variables differed for the independent variable, the Test of Between-Subjects Effects was observed, and the means were compared by Turkey's HSD test.

Results of Research

Pre-test

To obtain data on the digital literacy of students in grades 1 to 5, a pre-test was conducted, based on three checklists that were analysed in terms of grade level and gender.

Table 3
Pre-test Results – Grade

Grade	*N*	*M* (Checklist 1)	*M* (Checklist 2)	*M* (Checklist 3)
1	10	17.7	2.4	2.7
2	14	28.0	7.9	9.1
3	10	29.1	8.6	8.4
4	9	33.1	12.8	15.1
5	11	36.5	15.3	20.2

The results of the Kruskal-Wallis test showed that there were statistically significant differences between students' prior knowledge based on the grade attended for all three checklists: Checklist 1: $H(4) = 24.177$, $p = .001$ Checklist 2: $H(4)$: 18.192, $p = .001$; Checklist 3: $H(4) = 19.246$, $p = .001$. The largest differences occurred in basic computer skills, with the greatest variation occurring among the first-grade students that acquired the least knowledge compared to students in the other grades (Table 3) and had significantly lower competencies in using the Internet than the students of higher grades. The results also deviated from the results of the students of the remaining two classes of the first triennium, whose results were at a similar level. The same applied to fourth and fifth grade students. Greater differences between first and other grade students also emerged in testing the ability to find the correct web page, as well as skills related to navigating the web page and assessment, again in terms of skills acquired, with second and third grade students and fourth and fifth grade students differing in their ability to navigate the web page. The older the students, the more skills they had, and more progress was achieved. Very good computer skills (using a computer) were demonstrated by only one student in first triennium, a third-grade student, because of his prior knowledge, gained in computer course (basic computer skills) in school. Because of his prior knowledge, this student progressed significantly faster than his peers. In all grades basic computer skills predominated other researched skills, proportionately supplemented by the skills in finding the right website and navigating the web, and assessments, depending on the age of the students.

It was also checked whether there were gender differences in digital literacy. The mean rank of each checklist for each gender is shown in Table 4.

Table 4
Pre-test Results – Gender

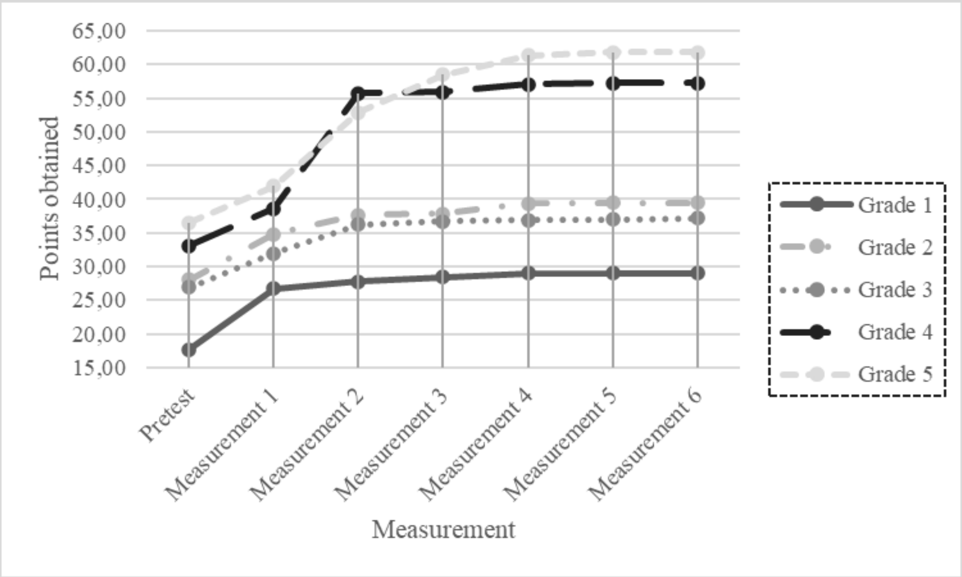
Gender	*N*	*M* (Checklist 1)	*M* (Checklist 2)	*M* (Checklist 3)
Male	30	28.65	29.17	28.28
Female	24	26.06	25.42	26.52

The results of the Mann-Whitney test showed that there were no statistically significant differences between the genders for any of the checklists: Checklist 1: $U = 325.500$, $p = .547$; Checklist 2: $U = 210.000$, $p = .383$; Checklist 3: $U = 336.500$, $p = .680$, so no further analysis was performed.

Acquisition of Digital Literacy Skills Based on Student's Grade

The results presented in Figure 1 show that digital literacy can be successfully developed in students from first to fifth grade, as students made successful progress at all grade levels, as indicated by the mean scores obtained on each measurement (grade 1: $\mu_{\text{pre-test}} = 17.70$, $\mu_{\text{meas.1}} = 26.70$, $\mu_{\text{meas.2}} = 27.80$, $\mu_{\text{meas.3}} = 28.40$, $\mu_{\text{meas.4}} = 29.00$, $\mu_{\text{meas.5}} = 29.00$, $\mu_{\text{meas.6}} = 29.00$; grade 2: $\mu_{\text{pre-test}} = 28.00$, $\mu_{\text{meas.1}} = 34.79$, $\mu_{\text{meas.2}} = 37.64$, $\mu_{\text{meas.3}} = 37.86$, $\mu_{\text{meas.4}} = 39.36$, $\mu_{\text{meas.5}} = 39.43$, $\mu_{\text{meas.6}} = 39.43$; grade 3: $\mu_{\text{pre-test}} = 29.10$, $\mu_{\text{meas.1}} = 31.90$, $\mu_{\text{meas.2}} = 36.20$, $\mu_{\text{meas.3}} = 36.70$, $\mu_{\text{meas.4}} = 36.90$, $\mu_{\text{meas.5}} = 37.00$, $\mu_{\text{meas.6}} = 37.20$; grade 4: $\mu_{\text{pre-test}} = 33.11$, $\mu_{\text{meas.1}} = 38.56$, $\mu_{\text{meas.2}} = 55.67$, $\mu_{\text{meas.3}} = 55.89$, $\mu_{\text{meas.4}} = 57.00$, $\mu_{\text{meas.5}} = 57.22$, $\mu_{\text{meas.6}} = 57.22$; grade 5: $\mu_{\text{pre-test}} = 36.55$, $\mu_{\text{meas.1}} = 41.91$, $\mu_{\text{meas.2}} = 52.82$, $\mu_{\text{meas.3}} = 58.48$, $\mu_{\text{meas.4}} = 61.36$, $\mu_{\text{meas.5}} = 61.81$, $\mu_{\text{meas.6}} = 61.81$). However, progress varied by student age or grade level, with fifth and fourth grade students making the most progress, followed by fourth grade students, and third grade students showing the least progress (Figure 1).

Figure 1
The Average of Points Obtained in Each Measurement According to Grade



The results of the repeated measures analysis of variance showed statistically significant difference in digital literacy acquisition as a function of student grade, F (28, 156) = 2.161, p = .002, Wilk's Λ = .308, partial η2 = .255. To determine how the dependent variable differs from the independent variable, the results of Tests of Between-Subjects Effects were considered. The data showed that grade level had a statistically significant effect on scores on all measurements: pre-test: F (4, 49) = 8.373, p = .001; partial η2 = .41; first measurement: F (4, 49) = 6.107, p = .001; partial η2 = .33; second measurement: F (4, 49) = 7.327, p = .001; partial η2 = .37; third measurement: F (4, 49) = 7.449, p = .001; partial η2 = .38; fourth measurement: F (4, 49) = 8.688, p = .001; partial η2 = .42; fifth measurement: F (4, 49) = 8.901, p = .001; partial η2 = .42; sixth measurement: F (4, 49) = 8.869, p = .001; partial η2 = .42.

The results and data presented in Figure 1 show that first, second, and third grade students, i.e., first triennium students, made less or slower progress than fourth fifth grade students, i.e., second triennium students. Mean scores were significantly different in: pre-test between grade 1 and 2 (p = .023), grade 1 and 4 (p = .001), grade 1 and 5 (p = .001); first measurement between grade 1 and 4 (p = .012), grade 1 and 5 (p = .001), grade 3 and 5 (p = .033); second measurement between grade 1 and 4 (p = .001), grade 1 and 5 (p = .001), grade 2 and 4 (p = .028), grade 3 and 4 (p = .027); third measurement between grade 1 and 4 (p = .003), grade 1 and 5 (p = .001), grade 2 and 5 (p = .014), grade 3 and 5 (p = .003); fourth measurement between grade 1 and 4 (p = .002), grade 1 and 5 (p = .001), grade 2 and 4 (p = .006), grade 3 and 4 (p = .042), grade 3 and 5 (p = .005); fifth measurement between grade 1 and 4 (p = .002), grade 1 and 5 (p = .0001), grade 2 and 5 (p = .005), grade 3 and 4 (p = .040), grade 3 and 5 (p = .005); sixth measurement between grade 1 and 4 (p = .002), grade 1 and 5 (p = .001), grade 2 and 5 (p = .005), grade 3 and 4 (p = .043), grade 3 and 5 (p = .004).

The interpretation in the context of the question of the specifics of the implementation of the IRT method in relation to class proved necessary. The first-grade students had the most problems with the acquisition of digital competences. It was most difficult for implementers to motivate them to participate, as they were mainly interested in playing with their peers (physical play, not digital). For the second and third grade students, the biggest obstacle was the use of the computer, which they themselves see primarily as a means to have fun. The method of working, which was planned for younger and older students alike, proved to be a problem.

One of the main reasons for the differences between younger and older students was the proportion of students who terminated the program earlier. Therefore, the reasons for terminating the program were checked, and the responses were examined from the point of view of the grade level of the students. The Pearson Chi-Square results indicated that the class the student was attending was a factor influencing the reason for termination $\chi 2$ (16, 54) = 31.862, p = .010.

Table 5

Reasons for the Termination of the Implementation of the Program

Grade	Highest level reached	Corona	Too demanding	No reason given	Other	Total
1	0	1	9	0	0	10
2	0	0	12	0	2	14
3	0	0	7	1	2	10
4	1	2	3	3	0	9
5	2	4	2	2	1	11
Total	3	7	33	6	5	54

The data presented in Table 5 show that the program was completed only in the case of second triennium students due to highest level reached – the acquisition of all digital competencies checked in checklists 1, 2, and 3. This is also the case with Corona as a reason for early termination, where the answers were placed that the students were oversaturated with computer work due class quarantines and the quarantine of both the implementers and the students, which did not allow the program to be fully implemented in time. The majority of implementers stopped the program because using the computer proved to be too challenging for students, with responses classified as not continuing the program because the student was not showing progress, the steps needed to take computer actions (for example saving the website and the like), are too demanding (not understandable for younger students), younger students rather wanted to play outside looking for unicorns, playing football, or playing a board game. Most of these responses were at the first triennium level (85 %). A few implementers did not give any reasons, and there were also responses that were included in the category "Other". In one case parents did not allow the continuation of the program because they were afraid that their child would be spoiled by using the computer too often and would want to use it too often, one student had an old computer and a bad internet connection, which meant that she had no motivation to work at all because sometimes she had to wait a few minutes for the website to load. Among the responses was also the answer that the student only wants and know how to use computer to play computer games.

Discussion

The starting point of the research was a qualitative study that evaluated the implementation of IRT for primary school students, finding that it is most appropriate for second triennium students, but that some adaptations are needed for younger first triennium students. The research participants pointed out that the IRT method is particularly valuable for the teacher, as it provides him/her with an opportunity and a tool for working in the classroom (Kordigel Aberšek & Kerneža, 2022) and the results of the presented quasi-experimental study confirmed the findings of the initial study. Teaching with the IRT is suitable for fourth and fifth grade students, and seems to be suitable for first to third grade students as well, but adaptations are needed for implementation at a lower school level (from first to third grade), as learning according to the IRT method is too demanding for them (implementers received the same instructions for implementation, regardless of the age of the students, based on the basic steps of the method.)

As part of research question 1, it was explored which digital competences predominate among younger students. The results of the study showed that younger students have significantly lower competencies in using the Internet than the students of higher grades, which is related to both basic computer skills and the skills children need for successful online learning, which is consistent with previous research, for example, by researchers Delgado et al. (2018), Legvart et al. (2021) and Legvart et al. (2022). Forzani and Leu (2012, p. 6) said that students need to start learning new literacy skills early if they are to adopt them by adulthood, which is not only necessary for them, but will also determine their future. Computer literacy emerged as the biggest problem based on the research results. Although the implementers were instructed that they could run the given program on any device (computer, mobile phone, tablet, etc., they all chose to use a computer, which was not a barrier for older students who were acquiring basic computer shills through the emergency distance learning. In future research, it would be interesting to introduce a tablet or mobile phone in half of monitored cases as a variable, since children are more accustomed to use this kind of devices (devices on touch) instead of a computer. Gorghiu et al. (2021, p. 716) even referred to mobile education as one of the most important achievements at the beginning of the 21st century. Mobile devices offer many opportunities for work, such as adding ideas and bookmarks, reading e-books, sharing information, assessing, and making photos etc., but they must be used properly and effectively, and children must also be involved in the learning process (Lamanauskas et al., 2020, p. 150).

The answer to the question on how digital literacy develops when the IRT method is implemented as an experimental program, was also addressed. IRT method was found to be suitable for developing digital literacy even in students from first to fifth grade, and a difference in the level of progress was found – older students made greater progress than younger ones. Leu et al. (2015) recommended a short research project with a partner for the younger students, which should be conducted on a single website, and the students should write their notes in a kind of Internet research journal. The fact that work on the Internet can quickly become too extensive and that students can get lost in their search for information was also confirmed, and it would be worthwhile to try out the option of shorter research. More time should be devoted to the basic acquisition of computer skills in the form of computer course or club for younger students. The second triennium students had the most problems not due to the lack of skills or motivation, but due to the oversaturation with computer work (the study was conducted during the Corona quarantine for people with risky contact, which means that the children were still often learning from home (some implementers reported about several consecutive isolations), which for the fourth and fifth grade students usually meant working many hours on and with the computers. It is important to point out that students in the higher grades also progressed successfully using the standard method of IRT, which means that major adaptations for older students are not necessary, but of course one must assume possible specific situations in the classroom. An element that could have affected the results of students of all ages, are the characteristics of pairs. Collaborative learning and research with peers are of great importance in the IRT method (Palincsar & Brown, 1984), and the program was designed so that the teacher implementers worked with the students one-to-one, i.e., they were his learning partners. In future research, the work should be planned so that the implementer leads the work of two participating children (working in pairs is also recommended by Leu et al. (2015)). In this way, the real purpose of the reciprocal teaching method would be achieved, and the possible influence of the implementer would be limited.

The third research question, related to the peculiarities of implementation of the IRT method in first five grades of primary school, depending on the grade level and gender, can also be answered. Gender was found to have no effect on the success of acquiring digital literacy skills. In examining other research that also addressed reading and learning in digital learning, conflicting reports were found. Yukselturk and Bulut (2009) examined gender differences in an online self-regulated learning environment and reported that there were no statistically significant mean differences among motivational beliefs, self-regulated learning variables and achievement in programming with respect to gender. Wu (2014), using data from the PISA database, found that girls performed better on knowledge of metacognitive strategies, navigation skills and printed reading assessment, but not in case of electronic reading assessment. Maximova (2020) also observed no differences in reading comprehension between male and female readers when reading online in the context of foreign language instruction. Other researchers reported that they have encountered significant differences between genders in their studies. Liu and Huang (2008) reported that female readers had a stronger preference for paper as a reading medium than male readers, whereas male readers exhibited a greater degree of satisfaction with online reading and concluded that genders differ on the dimensions of selective reading and sustained attention. Gender differences had also been reported by Cai and Du (2017), who said that men have more positive attitudes toward technology use than females, and that women have a lower attitude toward technology use than males. Contrasting research findings suggest that online reading and learning is a multidimensional construct that should be examined as such in future research.

Conclusions

Are we failing in integrating new literacies into primary grades? It is difficult to set a limit to what constitutes failure in this case, since there are not yet guidelines in this area (for example, in the form of a curriculum). But considering the future that is emerging not only in the school environment but in Society 5.0 (Industry 4.0) in general, an education is the foundation for this, the right answer could be: Yes. Children meet the digital world at the earliest, most tender age. Usually by getting their hands on a device whose functionality, purpose, etc. is not introduced to them by anyone, but through their research they discover the possibilities that the device offers them, while operating the device in a way that they discovered themselves and that is not necessarily optimal/appropriate. How to do it? With older students with using the IRT method, and with younger students with using an adaptation of the method, which still needs to be developed and researched for use with the youngest. Based on the results, working according to a specific program for the first grade is recommended. According to the data obtained for the other grades, the students could work according to the same program, i.e., the same program for the students of the second and third grade and the same program for the students of the fourth and fifth grade.

What also proved to be extremely important in the present research is that despite the fact that the critical use of the online environment is discussed, we are talking about children whose greatest need is still to look for shiny unicorns, play football, and enjoy themselves in their free time in contact with their peers.

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Declaration of Interest

The authors declare no competing interest.

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EXPERIENCES OF MOTHERS IN DEALING WITH STIGMA RELATED TO THEIR CHILDREN WITH AUTISM SPECTRUM DISORDER IN THE SAUDI CONTEXT

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Abstract

It remains unknown to what extent mothers of children with Autism Spectrum Disorder (ASD) are stigmatized. Children with ASD require special care to increase their attention and master the necessary motor and behavioural skills. In most society, particularly Middle East and Africa, mothers are largely the care providers for children while their partners concentrate on financial provision. Therefore, mothers experience a lot of challenges and stigma from some partners, family members, and the society. This qualitative phenomenological research examined the experiences of 15 mothers regarding the stigma associated with their children autism in Jeddah, Saudi Arabia. The research examined mothers' beliefs about the positive and negative roles that culture, education, and health institutions play in this regard. Five broad themes emerged from the analysis: mothers' concerns; reactions to the child's diagnosis; difficulties obtaining an ASD diagnosis; difficulty accessing resources; and cultural stigma (people's reactions). The researcher explored the themes and challenges of ASD through literature review and field Research (interviews). Findings showed the need to change structural and societal approaches toward ASD to share the burden among all stakeholders alleviating pressure on mothers.

Keywords*: children with ASD, cultural stigma, mothers' stigmatization, mothers experience, society positive roles, society negative roles*

Introduction

Autism Spectrum Disorder (ASD) and the issue of stigma in the context of the Kingdom of Saudi Arabia (KSA) is an area of interest because of knowledge and research gaps. In Saudi Arabia, people with ASD are still stigmatized, as are people with other disabilities. This research explored how mothers of children with ASD in Saudi Arabia perceive the stigma they encounter following their child's diagnosis of ASD. ASD stigmatization affects all parents, family members, and society; however, mothers bear a greater burden because of their connection and constant care for the child from birth; hence, their experience is different. Furthermore, mothers are preferred as the participants because the scope of the research, time limit, and financial constraints cannot allow an exhaustive exploration of all the family members. Thus, mothers are the best representation of the ASD problem in a family setting. In KSA and some parts of the developing world, ASD is considered unacceptable and stigmatized because people view disability as an abnormality (Brosnan & Gavin, 2021). It is also viewed stereotypically, with people holding entrenched opinions about ASD.

ASD is a series of developmental stages characterized by disorders in three areas: repetitive behavioural patterns in communication, problems with social interaction, and activities and interests (Harrop & Kasari, 2015). It is characterized by difficulties using communication for social purposes, an inability to adapt communication output to the context, difficulty following

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traditional conversational rules, and problems understanding implicit language as defined by a series of states (APA, 2013). In other words, ASD is associated with verbal and non-verbal social communication deficits and challenges in adhering to communication norms and forming and maintaining relationships (Bonis, 2016). The condition affects individuals' abilities to engage in social and academic activities. Restricted and repetitive behaviour and issues with social communication are the two core problems associated with ASD. The chief issue with repetitive and restrictive behaviour is that it is difficult to establish when to intervene because it is impossible to determine why such behaviours develop or their underlying mechanisms and management.

Parents of children with ASD often experience high levels of stress. Research by Bonis (2016) revealed a connection between parental stress and ASD. The results showed that parents of children with ASD suffer from high levels of stress and depression compared to parents of children without disabilities. This stress is attributable to the challenges that parents experience when trying to understand their children's behaviour and communication challenges. Compared with other parents, parents of children diagnosed with ASD are more likely to experience depression, confusion, and denial after their child's diagnosis of autism (Bashir et al., 2014; Bonis, 2016; Brei et al., 2015; DePape & Lindsay, 2015). Bonis (2016) outlined the challenges parents encounter when accessing ASD services. High-stress levels make it difficult for parents to care for their children adequately, and parents report increased financial burdens, marital problems, and stigma. Bonis (2016) explained that parents need access to stress management support groups and educational programmes to help them manage their emotions. Existing studies have concentrated on the stigma parents with ASD children undergo. However, the role of parenting differs in KSA; thus, it is relevant to explore mothers' experiences because of inconclusive findings, research, and knowledge gaps.

Purpose

The research aimed to find opinions and perspectives on mothers' stigmatization because of their children with ASD in KSA, particularly in the Jeddah area. They were completing this research with a complete knowledge gap about mothers' experiences and dealing with ASD-associated stigma.

Research Questions (RQ)

RQ is essential for guiding and narrowing research content to the project's purpose and most significant aspects. The following RQs were applicable.

1. How do mothers with ASD children deal with the stigmatization of the condition in KSA?
2. How does the culture propagate mothers' stigmatization because of their ASD children?
3. How has education affected attitudes to and awareness of their children's conditions?

Research Justification

In a patriarchal society, men earn more money than women, even in families where both parents work. Furthermore, women are expected to continue to play a traditional role at home, even if they are also active members of the workforce. In a relationship where both parents work, the woman will be responsible for caring for the children and ensuring that the husband's needs are met. She thus needs to balance two full-time jobs. For her, family responsibility is more important than anything else. In such a society, women must take care of their children and meet their needs. The man provides help and support, but he does not have to actively monitor the needs of children, including those with ASD.

An examination of the Saudi context clearly shows that mothers feel guiltier and fear that their children may be stigmatized because of their ASD diagnosis. In a culture where many mothers struggle with the social stigma associated with the birth of a child with special needs, much work still needs to be done to examine institutions and their role in reducing the stigma experienced by these mothers. By examining mothers' experiences of stigmatization, this research; therefore, sheds light on how cultural issues shape the experiences of mothers, as well as the institutional role that various institutions play in helping mothers to cope with the problems associated with this stigmatization of children who have been diagnosed with ASD.

Literature Review

A large and growing body of literature has examined the stress experienced by parents when raising children with ASD. Researchers agree that parents of children with ASD exhibit higher stress levels than other parents (Bonis, 2016; Brei et al., 2015; DePape & Lindsay, 2015; Miranda et al., 2015). Some studies have found that parents of children diagnosed with ASD experience high-stress levels. Raising children with autism is more taxing for parents than parenting a child without disabilities, as children with autism have a wide range of learning and developmental issues (Kinnear et al., 2016). Parents who experience physical and psychological stress are likely to find it challenging to prepare meals, help children with their homework, and fulfil their responsibilities, thus leading to parent-child conflicts (Kinnear et al., 2016). Researchers assert that disagreement between children and parents promotes the development of stressful situations in parents raising children with ASD.

Such tension can harm parenting, managing tantrums, and marital relationships. Parents need access to classes that teach them how to manage their stress to help them cope with their children with ASD. According to Bonis (2016), the importance of support groups for parents of children with ASD. Early diagnosis of ASD makes it easier to access the services and support groups that can improve the quality of life for children with ASD and their families. According to Bartholomew (2016), stigma is a Greek term initially referring to a mark cut or burned into the skin. Since the precise meaning of specific terms may vary from one society to another, the term stigma has a variety of definitions and interpretations. Commonly, however, it refers to a belief or an attitude that leads individuals to reject, fear, or avoid those they deem different (Liamputtong, 2013; Link & Phelan, 2011). Generally, a stigma is not a pre-existing characteristic but rather a linguistic affiliation that allows attributes to be associated with a particular stereotype.

Society tends to divide people into groups based on the characteristics they share. According to Link and Phelan (2001), stigma has four related components: those who decide and tend to label human variations; associating labelled individuals with particular detrimental characteristics; placing adversely labelled individuals or groups in discrete and isolated groupings from the non-stigmatized; and labelled individuals experiencing a loss of status. Identity can include professional roles, physical activities, and the self, and anything that changes one of these identities is considered a negative social stigma (Cronin & Mandich, 2015). There is also a stigma associated with people diagnosed with ASD, as some parents are apprehensive about how other people, especially the general public, perceive their child's health (Kinnear et al., 2016). In this regard, parents of children diagnosed with ASD may develop low self-esteem due to their child's condition.

Parents of children with high-functioning ASD must cope with the demands of raising a child with a disability and the social consequences of the disability (Bonis, 2016). According to Gray (2002), having ASD does not mean a lower IQ or poor verbal skills and does not necessarily involve schooling away from mainstream settings. However, children with ASD have difficulty forming and maintaining relationships and have uneven intellectual and cognitive functioning. One of the leading causes of the difficulty children with ASD face in social relations is that they are stigmatized by society. Numerous researchers agree that parents of children with disabilities experience stigma because their children are stigmatized (Bonis, 2016; Brei et al., 2015; DePape & Lindsay, 2015; Kinnear et al., 2016). Parents of children with ASD often have limited options for reducing the adverse reactions of society toward their children. Many studies have explored the stigma experienced by parents on social occasions or in the presence of their children (Bonis, 2016; Brei et al., 2015; DePape & Lindsay, 2015; Miranda et al., 2015). Parents of children with ASD face the same stigma as people with ASD.

Gray (2002) examined the difference between felt and staged stigma. Parents experience feelings of shame and embarrassment when they believe that others are criticizing them. On the other hand, when people avoid their parents, children face stigma. Gray found that many parents experience stigma and that parents experiencing stigma were less likely to have experienced it in the past. There was a significant spike in parents experiencing enacted stigma right after their child exhibited behaviour associated with ASD, and many children with ASD have been bullied or mistreated. However, the author found that both felt and enacted stigma exists and considerably affects parents. One of the findings was that mothers experience high levels of stigma compared to fathers and that the level of the presenting symptoms of ASD affected the level of stigma experienced by parents. Those whose children were more violent or aggressive experienced enacted stigma, unlike the parents whose children were passive. Evidence suggests that parents of children with ASD experience stigma associated with their child's diagnosis. While there have been some improvements in understanding stigma, these have not been explored in depth. Interviews by Gray (2002) indicate that most parents attribute stigma to different manifestations of similar negative experiences.

Research Context

While most people in Saudi Arabia know ASD is a neurological disorder, there is considerable confusion about its causes. Because the Saudi Arabian government and the Department of Special Education provide special education services, it is essential to promote awareness of this disorder widely. Awareness will ensure that more students with ASD receive tailored educational support and that their mothers receive the help they require (Alzaalah et al., 2015). In a research study on the relationship between autism and cultural context in the Saudi community, Alqahtani (2012) found that parents attributed the causes of their children's ASD to medical, psychological, and cultural factors. The suggested medical causes of autism include problems during pregnancy, vaccinations, and vitamin deficiencies. It has also been suggested that psychological problems associated with early childhood trauma due to the death of one or both parents may cause ASD. Some parents believe that the evil eye and black magic have led their children to develop ASD.

A survey of 367 Saudi citizens by Alman et al. (2017) found that most Saudis have heard of ASD and have some knowledge of it. Their findings indicate that the Saudi community pays little attention to the organic causes of this disorder because they believe it is simply a psychiatric problem. Many people believe that there are religious explanations for pregnancy complications that result in ASD. Most people believe that children with ASD can overcome this condition with appropriate intervention. There is a 6% chance that a child will be diagnosed with ASD in Saudi Arabia. Of these children, ASD is diagnosed in 42 out of every 1,000 boys and 189 out of every 1,000 girls. Most children in Saudi Arabia with ASD are diagnosed before age five (Alzaalah et al., 2015). There is a connection between ASD and the parents' age, with older parents being more likely to have a child with ASD. A child psychiatrist diagnoses speech delay in children. In addition to behavioural and pharmacological therapies, speech interventions are among the most widely used therapeutic interventions in treating children with ASD in Saudi Arabia (Alzaalah et al., 2015).

Whatever the cause of ASD, parents, especially mothers, have often been burdened with guilty feelings associated with their children's disorders, fearing they were the ones who had contributed to their children's diagnosis of ASD. Despite disagreement about the causes of ASD, the most common interventions used by parents to treat autism are cultural or informal, such as reading Quran verses or seeking help from religious healers. Treating the source of symptoms rather than the symptoms themselves is often preferred (Alqahtani, 2012). Alqahtani (2012) found that no parents reported using essential therapies focusing on behavioural, educational, or developmental interventions. Zeina et al. (2014) reiterate that fear of cultural stigma related to disability means that some mothers remain reluctant to seek help for their children with ASD. Some researchers have commented on the situation of women in the KSA, noting their status as caregivers and frequent lack of paid employment (Basaffar et al., 2016). It is essential to recognize the inequalities within the country and the importance of fixed gender roles for both men and women domestically.

Research Methodology

General Background

This research explored the experiences of individual mothers whose children had been diagnosed with ASD and were stigmatized in a Saudi context. The research focuses on the challenges associated with ASD in a patriarchal society, where mothers are the primary caregivers of children diagnosed with ASD. A phenomenological approach was used to understand the data collected during interviews with Saudi mothers whose children were diagnosed with ASD. The phenomenological approach focused on highlighting individual participants' experiences of specific phenomena. The use of a phenomenological approach was appropriate because this research focused on how mothers experience stigma directed toward their children with ASD. Rather than focusing on what these mothers experience, the phenomenological approach focuses on how their experience matters and highlights their unique experiences (Vagle, 2014). The methods are designed so that the results are trustworthy and can contribute to understanding how the Saudi cultural context affects mothers' experiences of stigma as a result of having children with ASD.

Sample Selection

The researcher recruited 15 mothers in Jeddah, Saudi Arabia, with children diagnosed with ASD. In patriarchal societies such as Saudi Arabia, women are more likely to have family responsibilities than to be in paid employment (Basaffar et al., 2016). Because of their role as caregivers, mothers are more likely to experience stigma related to their child's condition. For example, children with ASD may yell in public, ignoring the impact of their actions on the people around them.

The participants were selected based on the following criteria: mothers of children with ASD; in the age range of 22-42 years; and children in the age range of five to 12. The mothers were recruited after the university's Institutional Review Board permitted the use of human subjects. After the administration had approved the research, details were sent to three different groups on WhatsApp, and only individuals who met the criteria were invited to participate. Communication was used to clarify the risks and benefits of the research to parents. After a series of interactions, a group meeting was planned to explain the project's specific details to potential participants and provide them with details regarding the meeting's time, venue, and agenda. After the potential participants had been confirmed, the research team contacted them to arrange individual interviews. Individual contact was made to determine participants' schedules and to make arrangements to meet them on a one-on-one basis to conduct the interviews.

The demographic data for 15 mothers is shown in Table 1.

Table 1

Demographic Data of Mothers and Their Children Diagnosed with Autism

Participant	Mother's Age	Level of Education	Occupation	Gender of the child	Age of the Child
Mother 1	33 years	High school	Kindergarten Teacher	Boy	6 years
Mother 2	26 years	High school	Stay at home mother	Boy	5 years
Mother 3	26 years	Bachelor's degree in art	Elementary Teacher	Boy	7 years
Mother 4	24 years	Bachelor's degree in Arabic language	Stay at home mother	Boy	5 years
Mother 5	42 years	Bachelor's degree in science	High school Lab-teacher	Boy	10 years
Mother 6	25 years	Bachelor's degree in history	Stay at home mother	Boy	6 years
Mother 7	27 years	Bachelor's degree religious studies	Elementary Teacher	Boy	5 years
Mother 8	30 years	High school	Hairdresser	Boy	7 years
Mother 9	31 years	Bachelor's degree in art	High school teacher	Girl	8 years
Mother 10	29 years	Master's degree in accounting	Bank manager	Boy	7 years
Mother 11	22 years	Senior in history	Undergraduate student	Girl	6 years
Mother 12	38 years	Bachelor's degree in physics	Middle School teacher	Boy	8 years
Mother 13	41 years	High school	Stay at home mother	Boy	12 years
Mother 14	35 years	Bachelor's degree in science	High school teacher	Boy	10 years
Mother 15	23 years	Bachelor's degree in maths	Elementary teacher	Boy	7 years

A representation of the relationships between the themes and subthemes of the data is presented in Figure 1 below.

Instrument and Procedures

The researcher adopted interviews as the preferred instrument for data collection because they give in-depth information to help generate concepts and themes. Interviewees give their opinions and experiences, which are required for exploring the problem under investigation. Before the start of the interviews, the participants gave their consent to participate in the interview and for it to be recorded. The interviews were held in a local café to ensure the participants' comfort and lasted between 25 and 45 minutes. To ensure the accuracy of their responses, interviews with participants were audio-recorded. After each interview was completed, notes were taken, and the interviews were carefully transcribed as quickly as possible, using additional memos while the information was fresh.

Data Analysis

A phenomenological approach was used to analyse data from interviews with mothers in a Saudi context who have a child with ASD to understand their experiences and highlight the stigma experienced by these women. The analysis was completed using van Kaam's phenomenological data analysis method, which includes listing and preliminary grouping or levelling, reduction and elimination, analysis of invariant components, clustering, and theming (Sumskis & Moxham, 2017). The steps are followed by finalizing the invariant components and themes through the application and constructing a structural description of the personal experience for each co-researcher according to the individual structure description of each co-researcher (Sumskis & Moxham, 2017). Furthermore, it entails imagining changes to construct an individual structural description of the experience and then constructing a textural-structural description of the meanings and essences of the experience, incorporating the invariant constituents and themes for each participant (Sumskis & Moxham, 2017). Finally, from the individual textural-structural descriptions, a composite description of the meanings and essences of the experience was developed, representing the group as a whole.

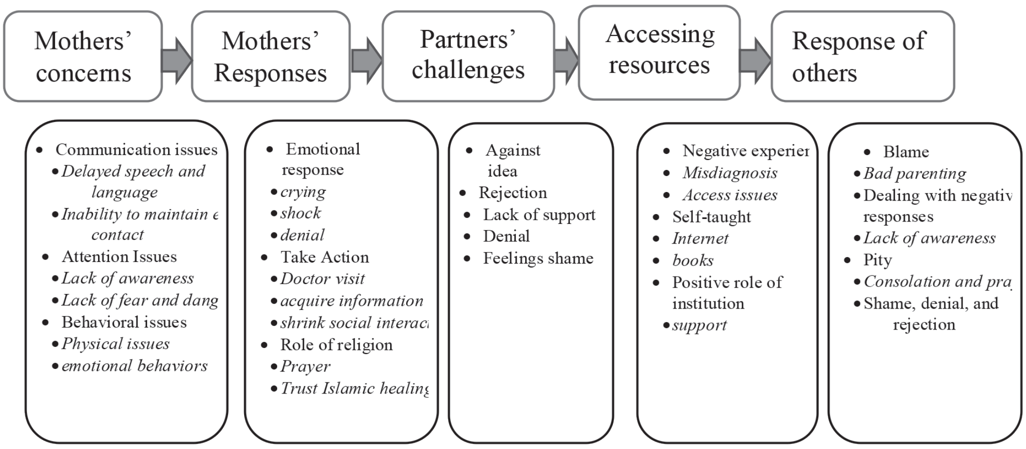
Researchers are careful in conducting their analysis when transcribing, organizing, and interpreting data. This research, in addition to the steps listed above, relied on the methods of epoché, phenomenological restoration, imaginary variation, and synthesis to collect and organize the emerging themes. A rigorous method of data analysis known as the analyst triangulation method was used to ensure the reliability and validity of this research. The co-reader was an education professor trained in quantitative and qualitative methods. Throughout the data analysis, parallel analysis was conducted, and the researchers met regularly to discuss the interpretation and understanding of the results.

Co-readers worked together to ensure that vocabulary was used accurately to describe the experiences of the mothers studied. When analysing the data, the transcriptions and translations were carefully examined, with attention given to unique phrases that explain how participants experienced particular phenomena (Creswell, 2016). The mothers' data were analysed using a modification of the van Kaam method for the analysis of phenomenological data. The process of data levelling was carried out through a review of the mothers' verbatim interview records. Epoché was used during the subsequent reading and reflections, respectively. The remaining list became the horizon for the mothers' experience of stigma. The immutable components from the mothers' data were organized from each transcript and clustered into new thematic groups. Some repetitive and distracting wording and irrelevant data were eliminated.

Research Results

Interview findings were opinions expressed in different patterns and phrases depending on the level of education and interpretation of the questions. Therefore, thematic analysis of the common responses led to five themes with respective subthemes. Figure 1 presents the themes and subthemes.

Figure 1
Invariant Constituents Organized by Theme and Subtheme



The five themes included: mothers' concerns, mothers' responses, partners' challenges, accessing resources, and the responses of others. Table 2 provides a list of the five themes and mothers' descriptions of their lived experiences that are represented by each theme.

Table 2
Themes and Descriptions of Saudi Mothers' Lived Experiences Related to Stigma Associated with having Children Diagnosed with Autism

Theme	Description	
Mothers' Concerns	Delayed speech	Beating himself
	Not communicating	Not scared of anything
	Crying	Short attention span
	No eye contact	Not interacting with others
	Excessive movement	Bad temper
	Lack of focus	Spinning in circles
	Lack of fear	Not responding to his/her name
Mothers' Responses	Surprised	Isolation
	Shock	Depressing/Helpless
	Denial	Attending conferences
	Crying	Searching for information
	Extremely sad	Meeting different doctors
	Sadness	Joined a group
	Stress	Defending their child
	Physically drained	Shrinking social interactions
	See doctors and specialist	Relying on Allah

Partners' Challenges	Against idea Rejection/ Feeling shame	Lack of support Denial
Accessing Resources	Negative experiences Lack of reliable resources Limited resources Expensive	Misdiagnosis Book and internet Educational games Support/Providing guidance
Responses of Others	Blaming the mother Bad parenting Dealing with disrespect Negative responses Rejection	Lack of awareness Responding with pity Prayers and soft words Feeling ashamed Denial

The 15 mothers in Saudi Arabia described their experiences of stigma directed toward their children with ASD. Their experiences are described in the following sections and are organized by categories from the themes that emerged from the data.

In presenting the findings, it is essential to describe the coding used. To facilitate the horizontalization of mothers' statements in the interview transcripts, M1 indicates statements from mother number 1. The number next to the "M" indicates the numbered horizon in the transcripts. When a statement made by M1-1 is presented, it indicates the horizon's location in the interview with the mother. The M1-1 statement, therefore, indicates that the statement was made by mother number 1 and was the first horizon gleaned from her interview. This numbering system was used with all the mothers. This system makes it easier for others to examine the transcripts and verify the claims made.

The mothers reported that some individuals attributed their children's erratic behaviour to poor parenting, and when the mothers were blamed, they often felt guilty. Their children were sometimes disrespected when people called them retarded, or weird or accused them of being disrespectful of social norms. Mothers indicated that many individuals offered prayers to help their families deal with challenges. Although one of the mothers did not face difficult situations where she was blamed or disrespected, she was mainly "unhappy with the feeling of pity that others directed" (M4-33) at her.

The negative responses of some fathers also contributed to the stigma. Some mothers found dealing with their husbands' denial of their children's conditions challenging. Mother 10 explained, "My husband completely refused to let me take him to any centres or even diagnoses him" (M10-19). Additionally, some fathers ignored their responsibilities regarding caring for their children, even though they needed significant support. The shame that some mothers experienced also contributed to isolation. The mothers often attributed their experiences to the lack of others' awareness.

The findings show that mothers encountered shock, sadness, and denial when dealing with their children's condition. Mother 8 explained, "my husband and I became extremely sad and cried when we figured out that he has autism. We were shocked because he is our first child." (M8-6). Many mothers experienced stress when dealing with their children's diagnosis, consistent with the experiences reported in the literature. Additionally, the research found that parents of children with ASD experienced depression, confusion, and denial. However, when mothers started seeking help for their children, their initial negative responses changed. The mothers reported that until there is greater awareness of this condition, they would continue experiencing stigma by association.

Mothers were primarily concerned about their children's communication skills, inattention, and behavioural issues. Of the 15 mothers interviewed, 12 were concerned about their children's poor communication and non-verbal communication skills. For example, mother 1 argued that she was primarily concerned with "delayed speech and language" (M1-6). Other mothers were concerned about their children's lack of attention since this could put them in danger. Mother 2 described this point clearly when she explained that her child seemed as if "he was not aware of things around him as if he did not hear them. He was not even aware of danger" (M2-2). Seven of the 15 mothers interviewed were concerned that their children's inability to develop proper behaviour impedes their social and emotional development. Mother 5 asserted that she was concerned because her son would "strangely move his head, spinning fast, and engage in excessive movement" (M5-2).

The mothers indicated that they used the Internet to help them learn about and cope with their children's diagnoses. Mother 10 emphasized this when she said, "I read a lot of articles from Google, and I watched a lot of videos on YouTube about this disorder." (M10-7). The Internet allowed them to learn more about their children's condition and connect with virtual friends dealing with the same issue. The findings indicate that some mothers relied on their faith to help cope with their children's diagnosis and as a means of healing. Faith also guided them to behave appropriately regarding their children's diagnosis. Their reliance on Allah stemmed from believing their faith could help provide the needed answers. Mother 12 emphasized that "the effect of trusting God is a miracle. I believe in leaving it to God and trusting him and praying. Keeping that connection with God is the solution." (M12-41). This finding supports Alqahtani's (2012) finding that the most common interventions used by parents to treat ASD were cultural and other informal interventions, such as reading Quranic verses (p. 19).

Some mothers reported having had negative experiences with specialized institutions. They reported that the diagnoses they received were confusing and ultimately inaccurate, which led them to lose trust in some institutions. Additionally, after consulting various institutions and specialists, there were problems with contradictory diagnoses, which mothers attributed to a lack of standard regulations and guidelines. Mother 4 clarified this point when she stated, "I went to hospitals to get him checked, and I went to centres for a diagnosis. However, I received different contradicting diagnoses." (M4-11).

Some mothers also had issues with access, having been rejected for services due to the institutions' lack of preparedness to accommodate children with disabilities. Mother 3 explained how she did not have access to many public institutions, and they did not accept her child due to his condition. She stated, "Many public schools do not accept his condition because they are not qualified to have any child with disabilities." (M3-16).

The findings indicate that institutions supported mothers. Through the centres, some mothers established contact with other women who provided advice and shared their experiences. Additionally, some institutions provided informative workshops and lectures, teaching mothers more about their children's condition. Specialists in the centres also provided mothers with exceptional guidance on essential resources. Mother 15 explained, "I received some guidance from the specialized centres, and after that, my husband and I decided that these centres would benefit our child." (M15-22).

Medical and learning institutions helped mothers find people to talk to about their children's condition. Many mothers praised their doctors, indicating that they guided them to explore different beneficial resources. The connections mothers established with other women were productive. The knowledge that mothers gained was often helpful in a culture where individuals often misunderstood the condition. Mother 15 explained, "I went to all the workshops, shared my experiences with other mothers, and tried to learn from their experiences. I got to meet many parents who have a child with a disability. Honestly, I learned a lot from these workshops and lectures." (M5-20). Mothers with this new knowledge could explain their children's conditions to questioning family members who often blamed them for the erratic behaviours of their children. Not only did the centres provide initial guidance, but some continue to provide long-term helpful support to some mothers.

Discussion

The findings provided insights into how mothers react to the social stigma directed at them when their children are diagnosed with ASD. It also presents the social, cultural, and perceived roles of specialized agencies in Saudi Arabia, as well as the experiences and concerns of the Saudi people. The data were collected and analysed from different age groups of mothers to offer a complete picture of their experiences. The research was open to all mothers, regardless of their children's gender or severity of their condition, as long as their children were between the ages of five and 12 since gender and the severity of ASD was not the focus of this research.

The process of imagining various possibilities was used to make sense of anything not explicitly stated by the participants. By engaging in imaginative variation, the researcher moves beyond the facts to arrive at different possible underlying meanings behind participant stories (Messick, 1995). After listening, translating, reading, and rereading these mothers' stories, such a process facilitated the attempt to break down the data into different themes and sub-themes. The researcher must try to understand what the person is saying and then figure out their hidden meaning, a creative process accomplished through variation. None of the mothers used the term "stigma" to describe the reactions they faced. However, their isolation was motivated by the denials spoken of by some and the embarrassment brought about by the condition. The tendency to seek evacuation was understood as a form of stigma. After carefully analysing the transcripts from each interview, five major themes were identified and validated; these described individual mothers' experiences of the stigma directed toward their children.

The results of this research collaborated with previous researchers' findings; hence, it is viable and can be replicated with the same outcome. The differences in mothers' stigmatization were associated with many external factors and implications. This outcome confirms what earlier researchers had indicated. According to Mash and Wolfe (2010), the reactions of parents and the impact of their child's diagnosis vary depending on their work environment, family setting, and level of education. Educated people may react to societal challenges differently. Cultural, economic, and social experiences are changed by education (Mash & Wolfe, 2010). In this research, mothers responded differently regarding the stigma associated with having a child with ASD in the Saudi context. Therefore, the influence of mothers' professions and education was considered in this research to provide insight into how mothers managed the challenges they faced due to their children's conditions. Another objective of the research was to examine how education affected attitudes to and awareness of their children's conditions.

Research findings showed that many mothers depend on doctors’ diagnosis to know the condition of their ASD children. Unfortunately, fewer mothers seek doctor services or consultation earlier enough. This delayed medical consultation leaves many mothers and families unaware of their children’s conditions and continue to experience stigmatization associated with the condition. This realization conforms to what earlier researchers had discovered. According to Alzaalah et al. (2015), most people in KSA consider children with ASD are more of a curse, not a medical condition; thus, they seek spiritual interventions. Awareness of this condition will help mothers attain tailored intervention and reduce mother’s stigmatization (Alzaalah et al., 2015). Alman et al.’s (2017) study showed that many are aware of the condition but pay little attention because they consider it a psychiatric problem.

Research findings showed that support systems mothers have had are helpful in reducing stigmatization. They will help to demystify and debunk misconceptions linked to ASD stigmatization and foster better intervention strategies. The stigmatization is associated with negative responses mothers get from their husbands, family members, and the community. They all agree that dealing with negative vibes from their loved ones make it harder to handle the situation better. Apart from the stigmatization, mothers were affected by delayed communication capability, inattention, and behavioural challenges of their children. As much as they tried to rely on religious beliefs and sought spiritual healing, they came to understand that ASD is a medical condition that requires healthcare intervention, and they are exonerated from blame and guilt. They should seek support system and continue to engage with various stakeholders to abolish stigmatization through awareness and sensitization campaigns.

Conclusions and Implications

This research found that many mothers had negative attitudes toward their children's condition and felt overwhelming sadness when they found their child had ASD. Although learning more about the disability helped many people feel comfortable, many still struggled with the social stigma. While many people have found that specialized institutions can be helpful in understanding and dealing with children with ASD, much more needs to be done to increase public understanding and empathy toward those with ASD. The mothers' experiences show that much needs to be done to improve the quality of services for people with ASD in Saudi Arabia. The lack of a clear policy structure about who can diagnose autism and how that diagnosis should be made makes it difficult for mothers of children with ASD to obtain an appropriate diagnosis. Many mothers said that some of the public facilities they visited offered very little support, which can be a problem for people with disabilities, for example, the availability of skilled workers.

In the context of Saudi Arabia, policymakers should be encouraged to establish clear guidelines to ensure correct diagnosis for people with disabilities, using standards similar to those used in other countries. The mothers' experiences in this research suggest that those making the diagnosis did not have the necessary skills and were not specialists. Some mothers had to rely on their family doctor to diagnose their children. These findings support strong recommendations that institutions must take this matter seriously and make many structural changes to provide the services these children and their families need. A key policy priority should therefore be to accommodate all people with disabilities and provide them with long-term care, including those diagnosed with ASD in Saudi Arabia. The implication is that the research increase awareness of the need for institutional and cultural changes to alleviate mothers from stigmatization due to ASD children. ASD is a public and societal health burden that all stakeholders must address.

Declaration of Interest

The authors declare no competing interest.

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